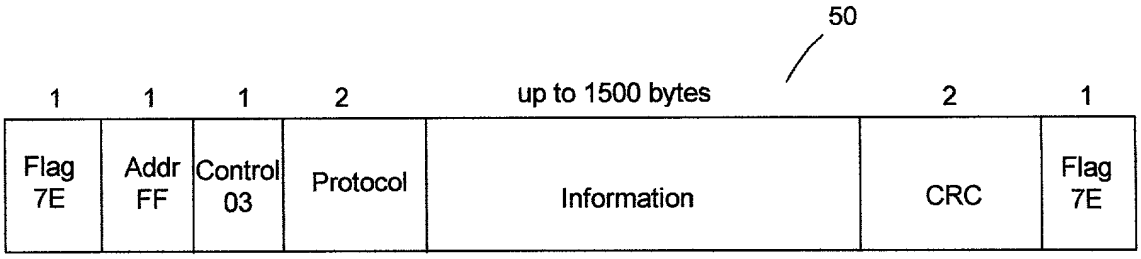
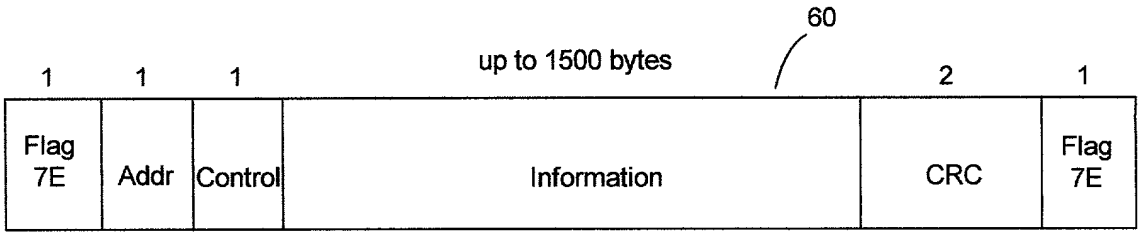
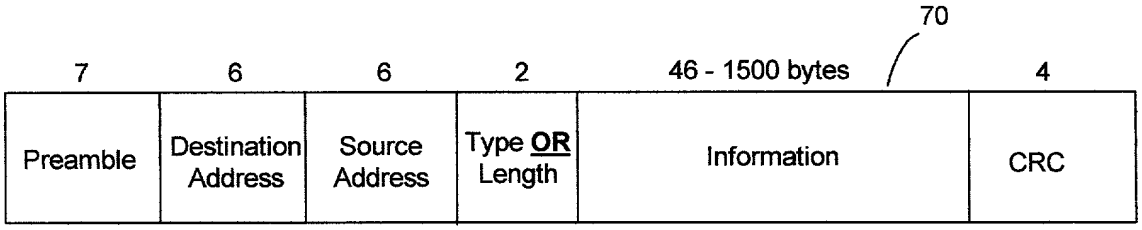
Typical Frame Format



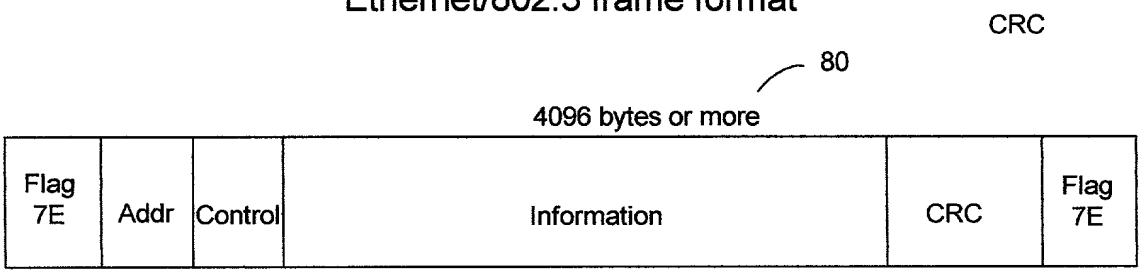
Point-to-point frame format



Frame Relay frame format



Ethernet/802.3 frame format



HDLC frame format

FIG. 1

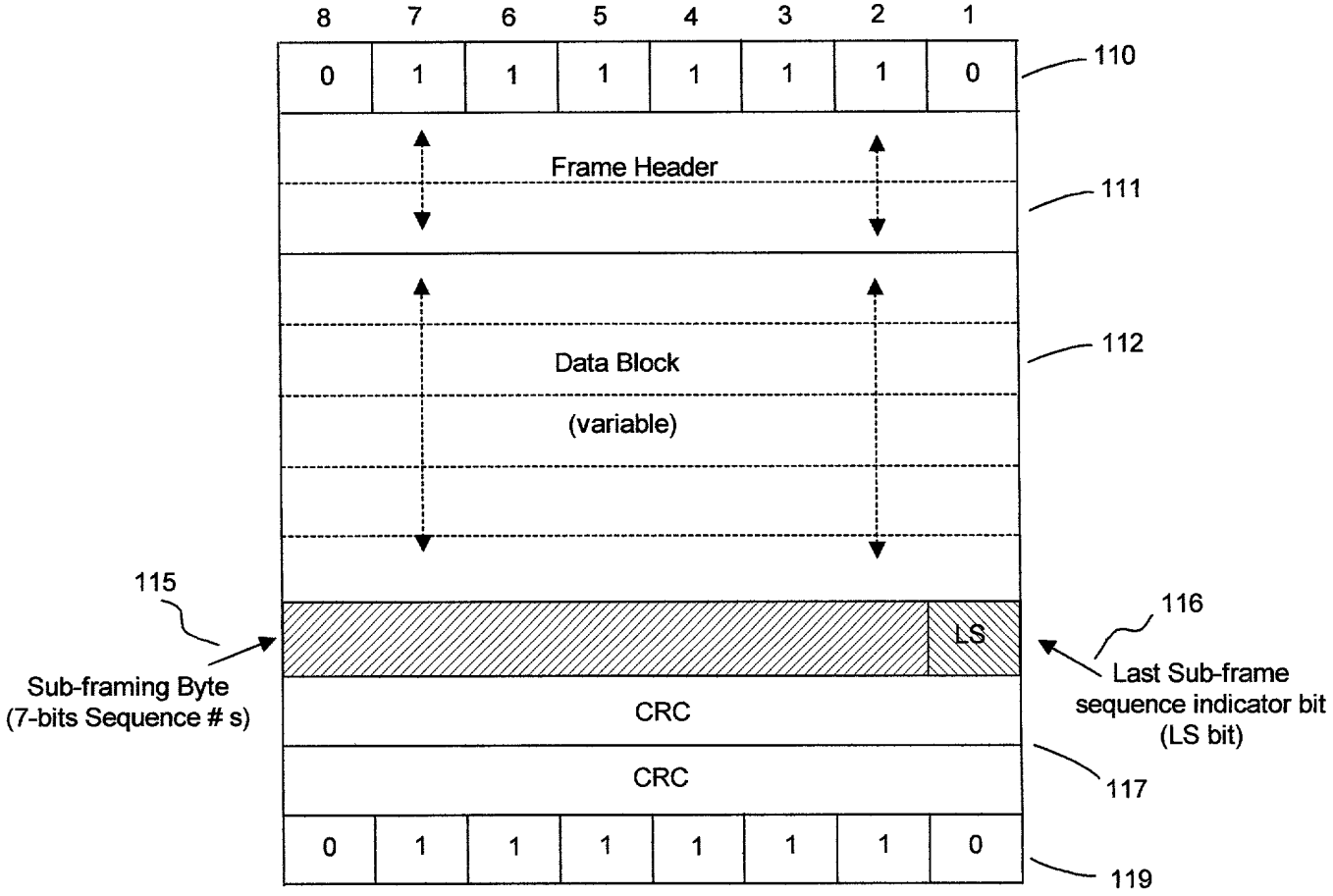

8 7 6 5 4 3 2 1
0 1 1 1 1 1 1 0
110
Frame Header
111
Data Block
(variable)
112
115
LS
116
Sub-framing Byte
(7-bits Sequence # s)
Last Sub-frame
sequence indicator bit
(LS bit)
CRC
CRC
117
0 1 1 1 1 1 1 0
119

FIG. 2

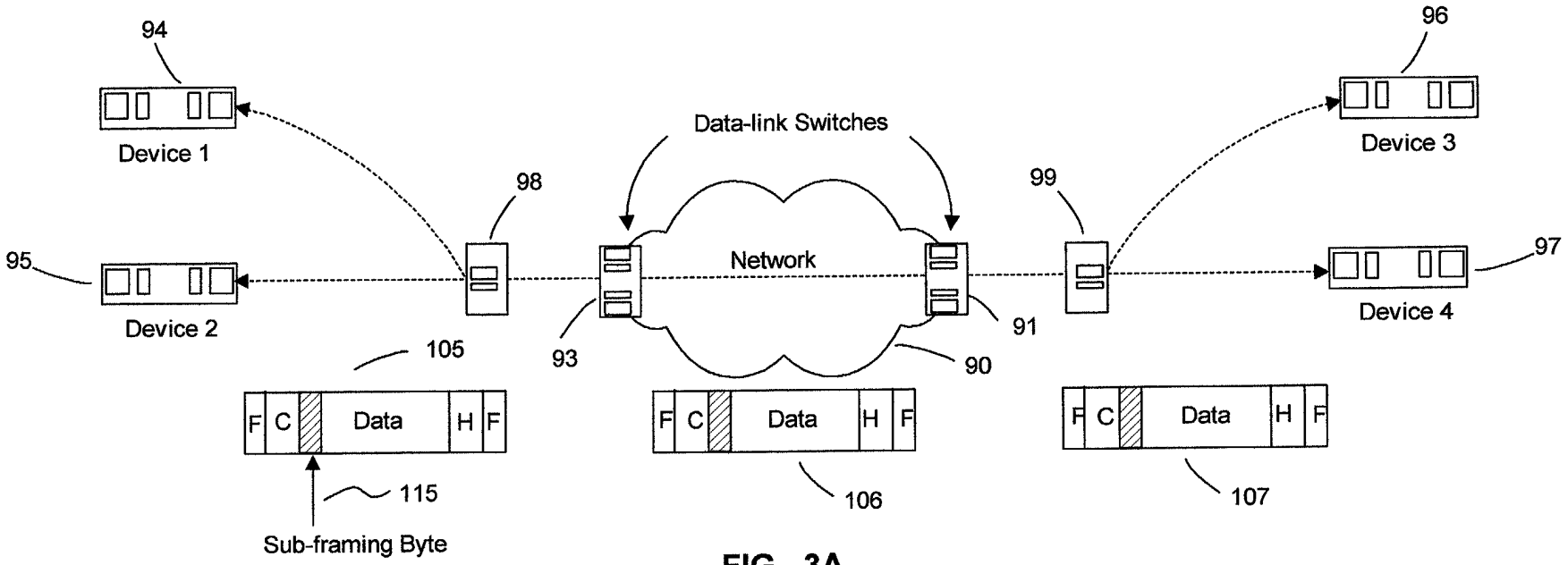

94
Device 1
96
Device 3
Data-link Switches
98
99
95
Device 2
Network
97
Device 4
93
91
105
90
F C Data H F
F C Data H F
F C Data H F
115
106
107
Sub-framing Byte

FIG. 3A

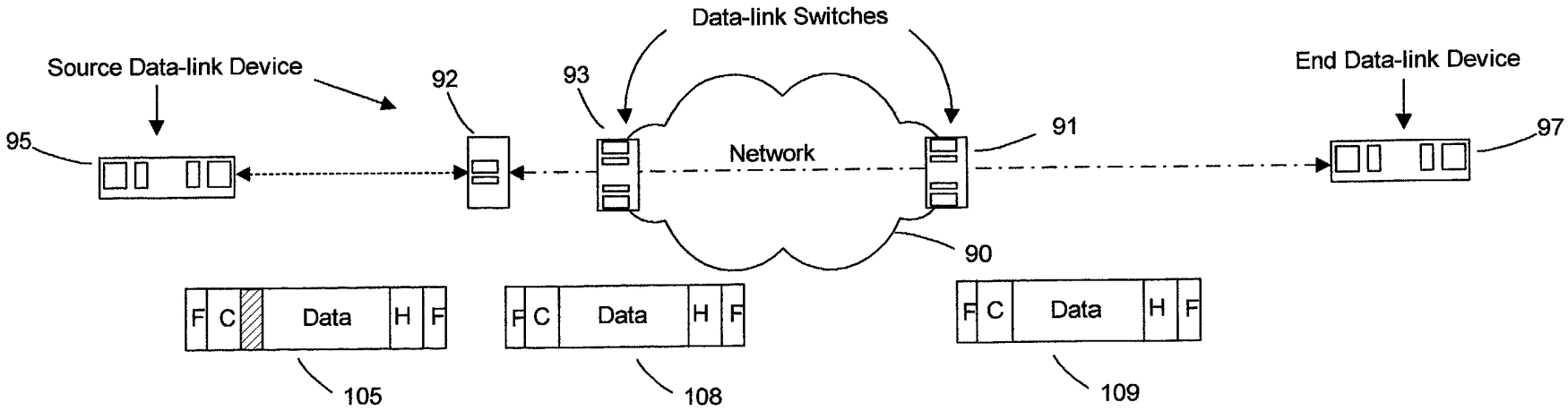

Data-link Switches
Source Data-link Device
92
93
End Data-link Device
95
Network
91
97
90
F C Data H F
F C Data H F
F C Data H F
105
108
109

FIG. 3B

Sequence byte range assignment:

Sequence range assigned for priority service N_1
$x_1 \longrightarrow x_i$

Sequence range assigned for priority service N_k
$x_j \longrightarrow x_k$

Sequence range assigned for priority service N_z
$x_y \longrightarrow x_z$

Example:

Voice priority service N_V
1 ⟶ 15

SNA traffic priority service N_S
16 ⟶ 50

LAN traffic priority service N_L
51 ⟶ 127

FIG. 4A

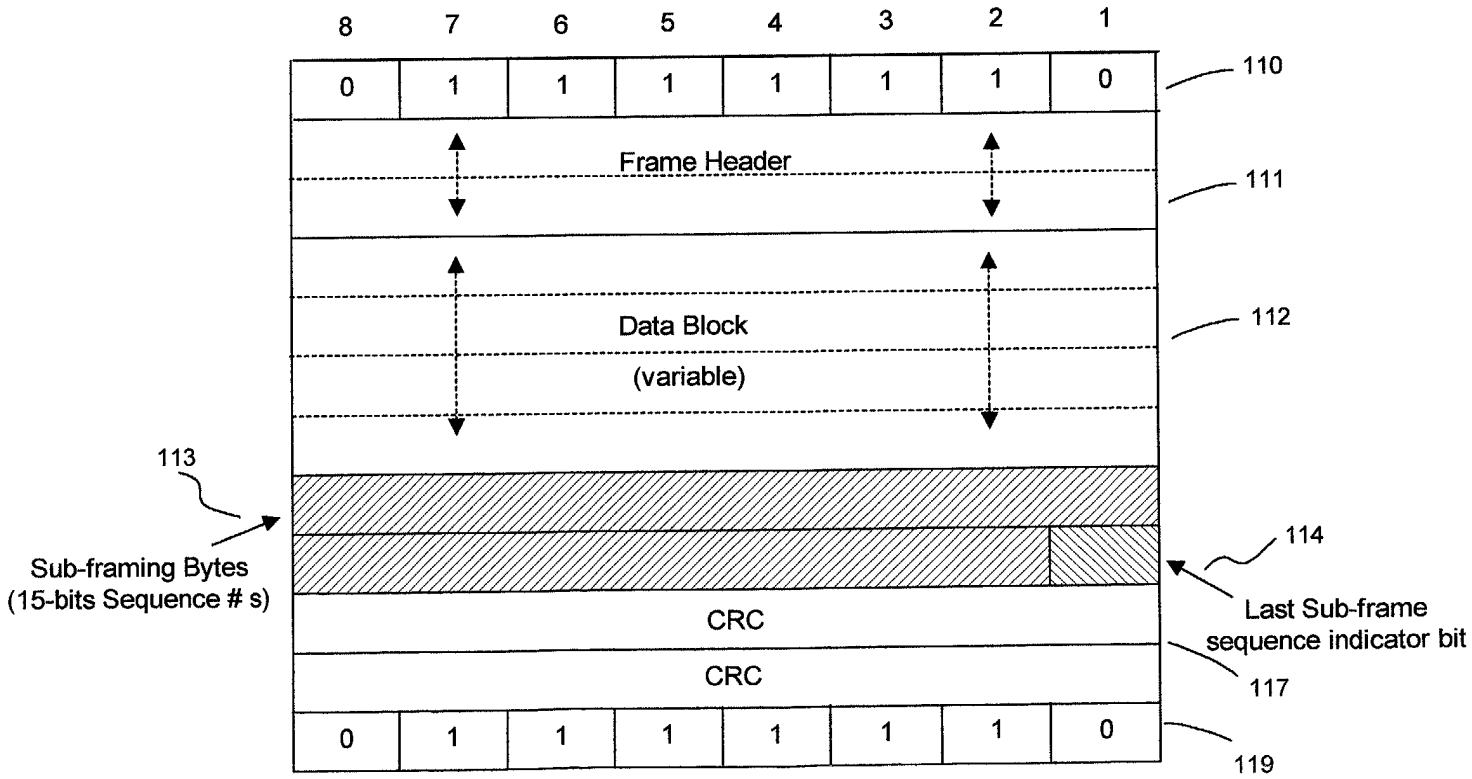


FIG. 4B

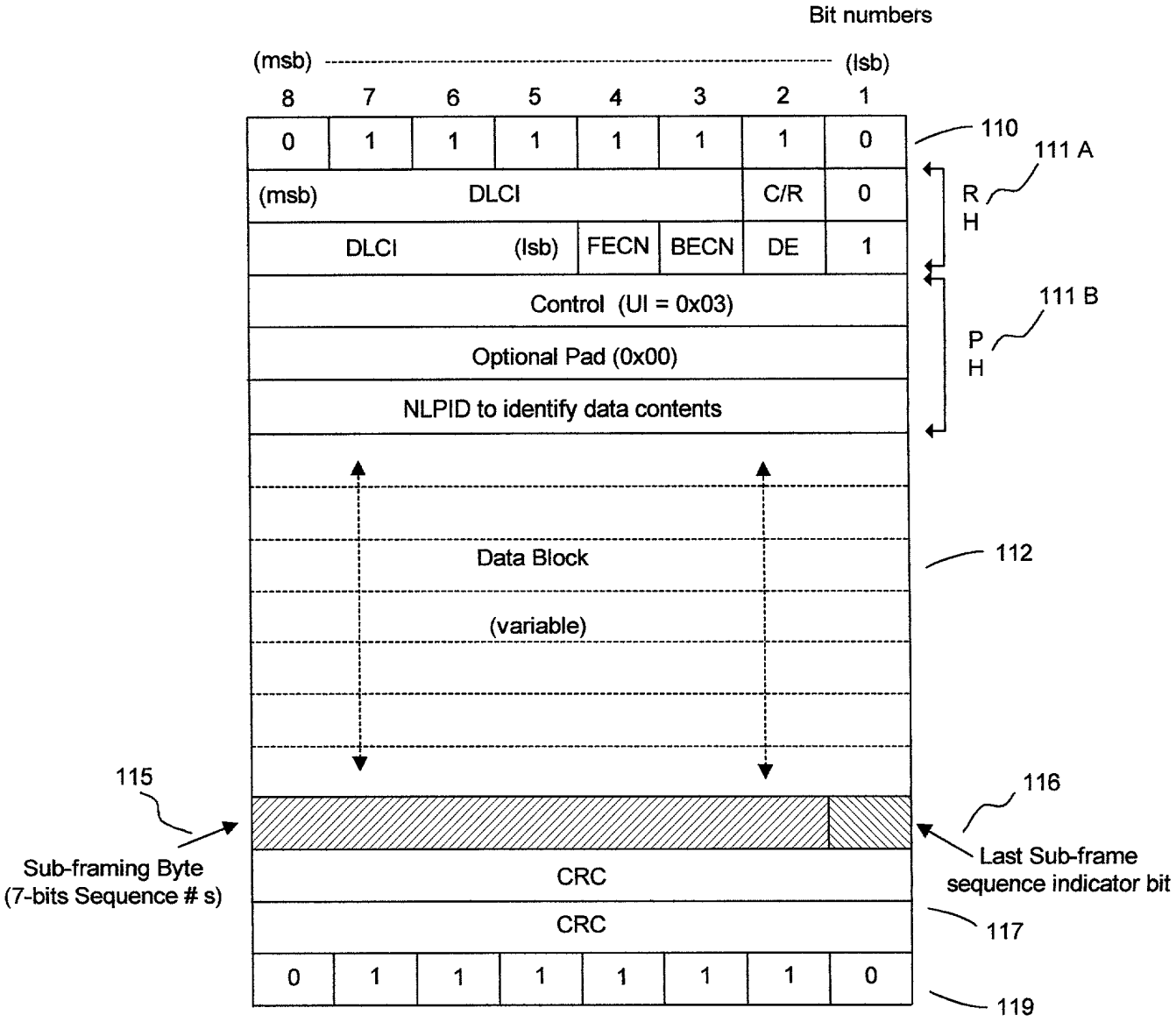

Bit numbers
(msb)
(lsb)
8 7 6 5 4 3 2 1
0 1 1 1 1 1 1 0
110
111 A
(msb) DLCI C/R 0
R H
DLCI (lsb) FECN BECN DE 1
111 B
Control (UI = 0x03)
Optional Pad (0x00)
P H
NLPID to identify data contents
Data Block
(variable)
112
115
116
Sub-framing Byte
(7-bits Sequence # s)
Last Sub-frame
sequence indicator bit
CRC
CRC
117
0 1 1 1 1 1 1 0
119

FIG. 5

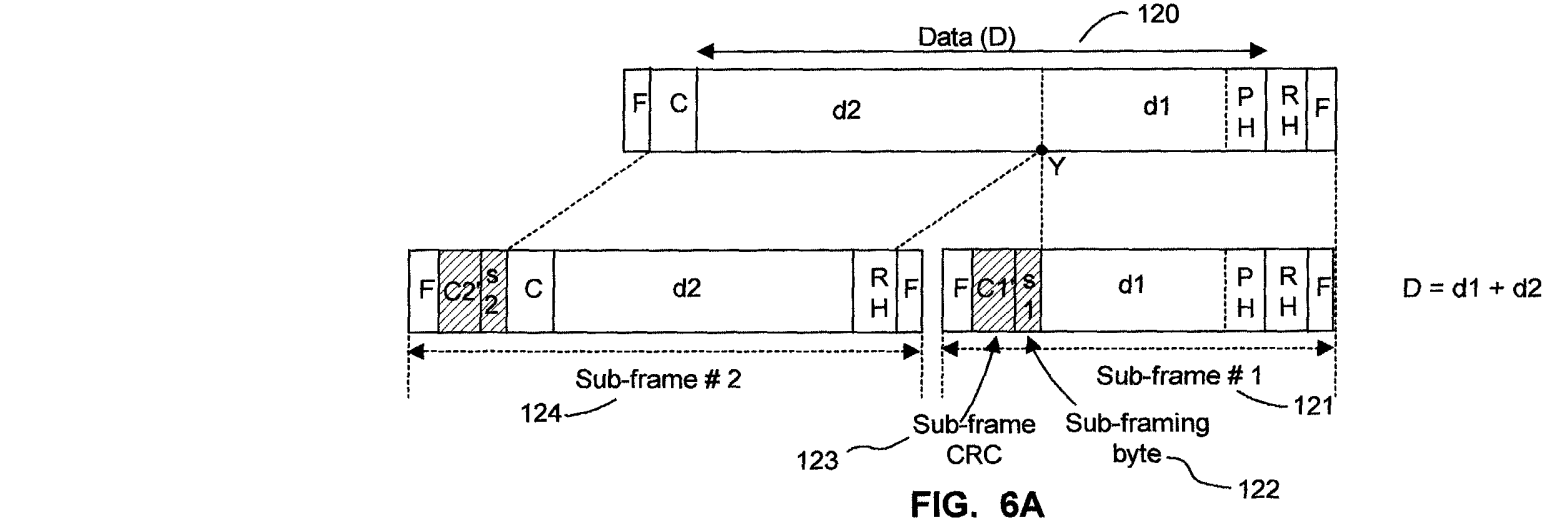

Data (D)
120
F
C
d2
d1
P H
R H
F
Y
F C2' s 2 C d2 R H F
F C1 s 1 d1 P H R H F
D = d1 + d2
Sub-frame # 2
124
Sub-frame # 1
121
123
Sub-frame CRC
Sub-framing byte
122

FIG. 6A

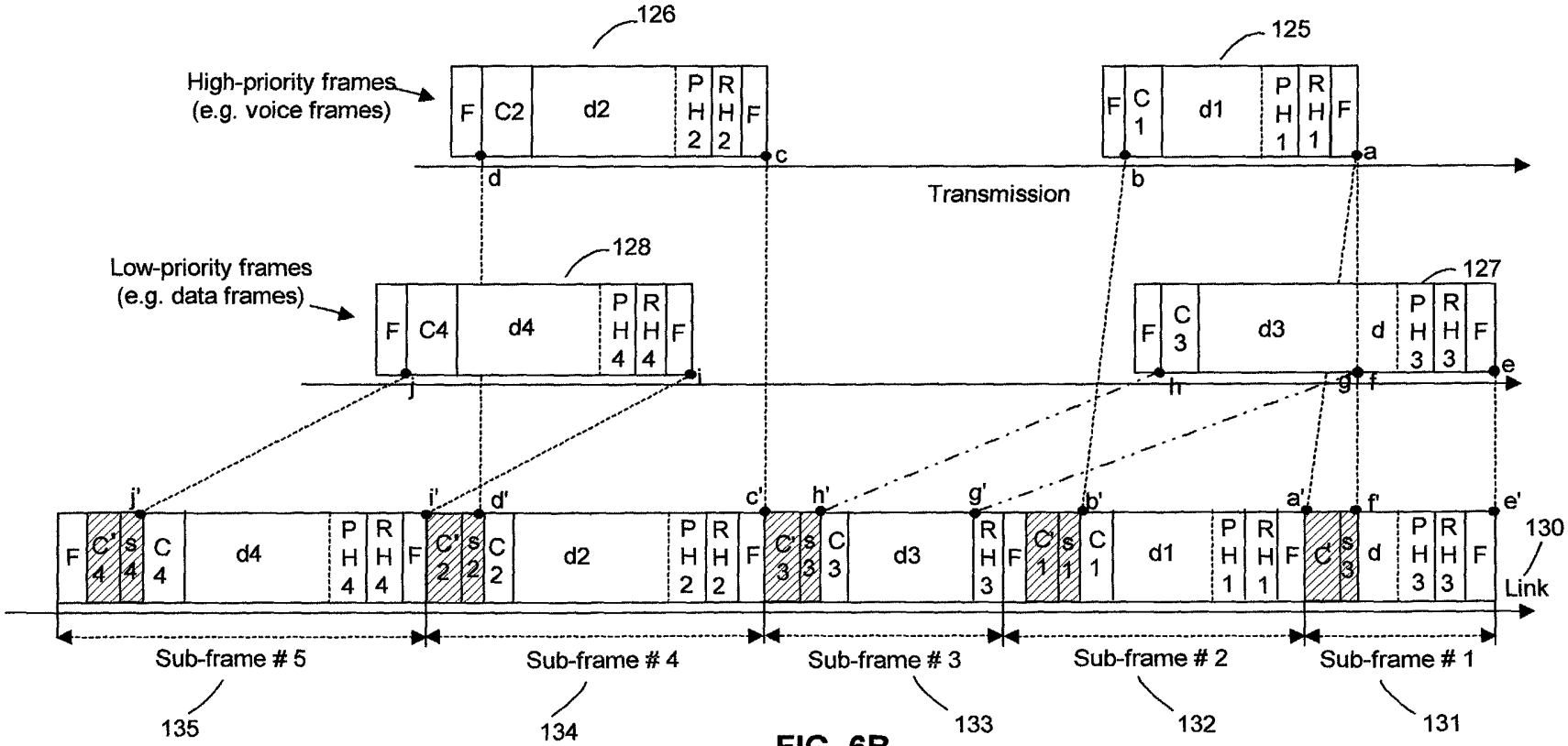

126
High-priority frames (e.g. voice frames)
F C2 d2 P H 2 R H 2 F
125
F C 1 d1 P H 1 R H 1 F
Transmission
Low-priority frames (e.g. data frames)
128
F C4 d4 P H 4 R H 4 F
127
F C 3 d3 d P H 3 R H 3 F
130
Link
Sub-frame # 5
Sub-frame # 4
Sub-frame # 3
Sub-frame # 2
Sub-frame # 1
135
134
133
132
131

FIG. 6B

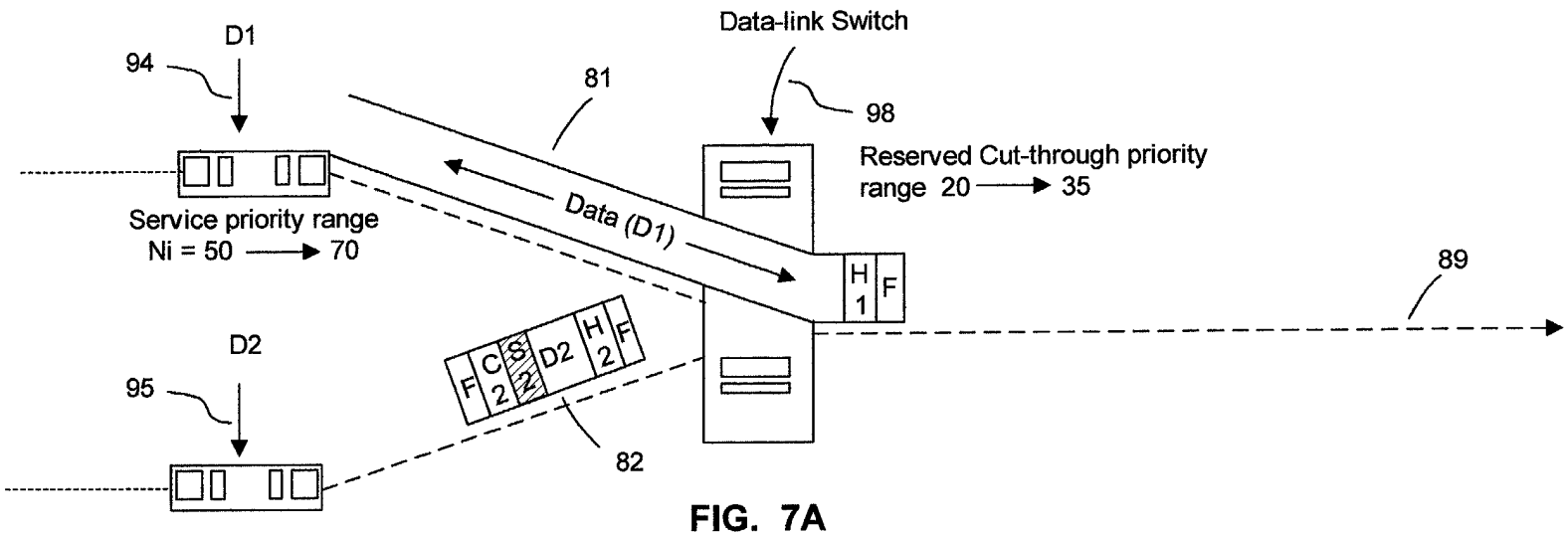

D1
94
Data-link Switch
81
98
Reserved Cut-through priority
range 20 → 35
Service priority range
Ni = 50 → 70
Data (D1)
H 1
F
89
D2
95
F
C 2
S 2
D2
H 2
F
82

FIG. 7A

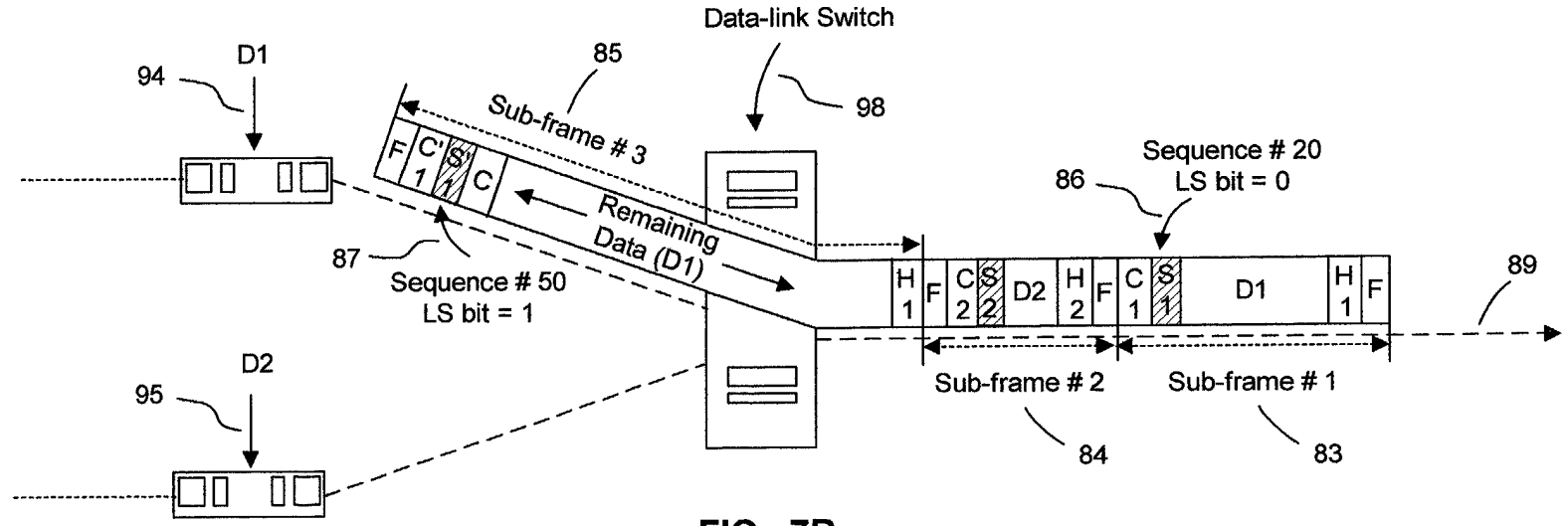

Data-link Switch
D1
94
85
98
Sub-frame # 3
F
C' 1
S 1
C
Remaining
Data (D1)
Sequence # 20
LS bit = 0
86
87
Sequence # 50
LS bit = 1
H 1
F
C 2
S 2
D2
H 2
F
C 1
S 1
D1
H 1
F
89
D2
95
Sub-frame # 2
Sub-frame # 1
84
83

FIG. 7B

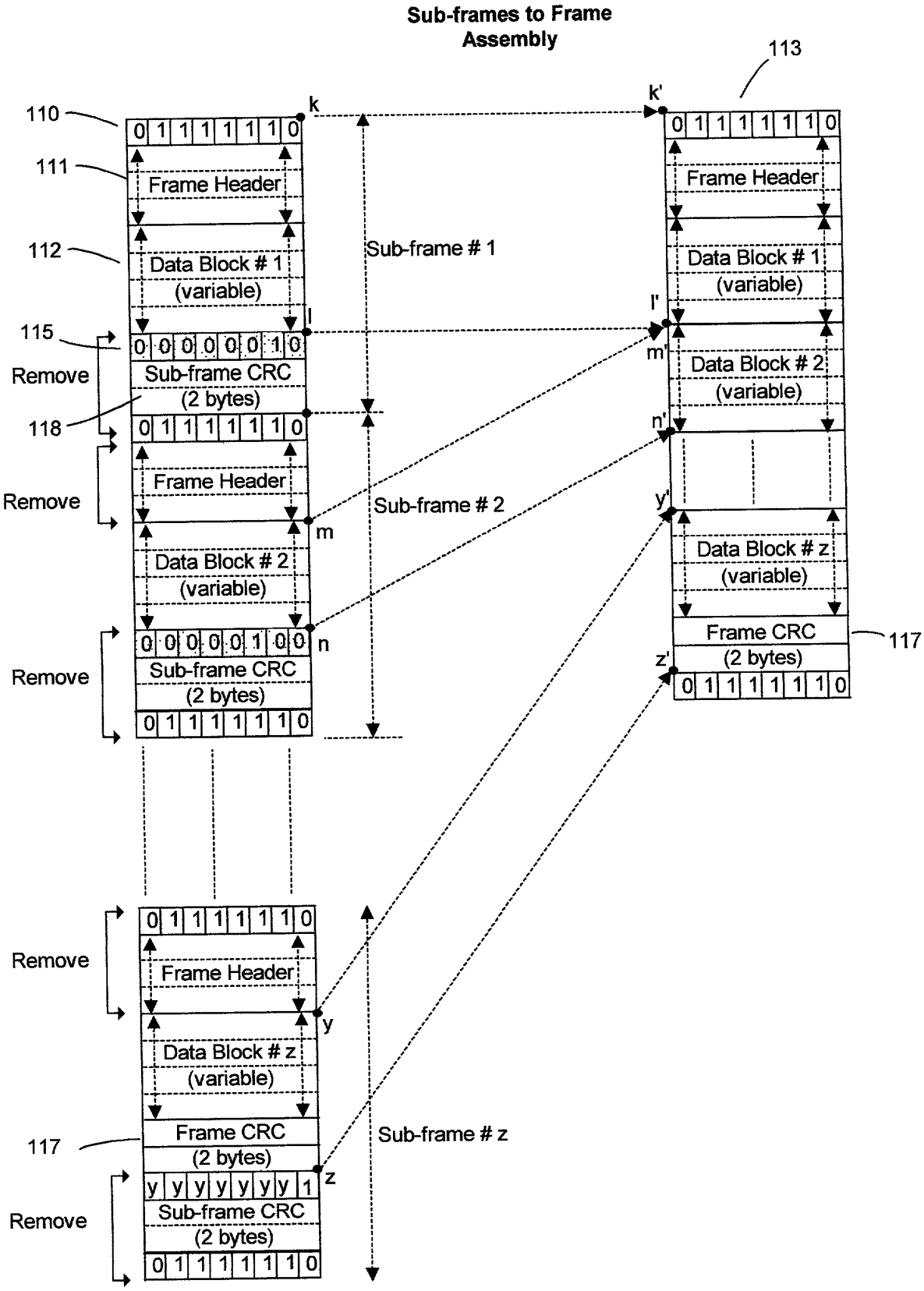

Sub-frames to Frame Assembly
113
110
111
112
115
Remove
118
Remove
Remove
Remove
117
Remove
Remove
k
k'
Frame Header
Data Block # 1
(variable)
Sub-frame # 1
l
l'
0 0 0 0 0 0 1 0
Sub-frame CRC
(2 bytes)
m
m'
Data Block # 2
(variable)
Sub-frame # 2
n
n'
0 0 0 0 0 1 0 0
y
y'
Data Block # z
(variable)
Frame CRC
(2 bytes)
z
z'
y y y y y y y 1
Sub-frame # z
0 1 1 1 1 1 1 0

FIG. 8

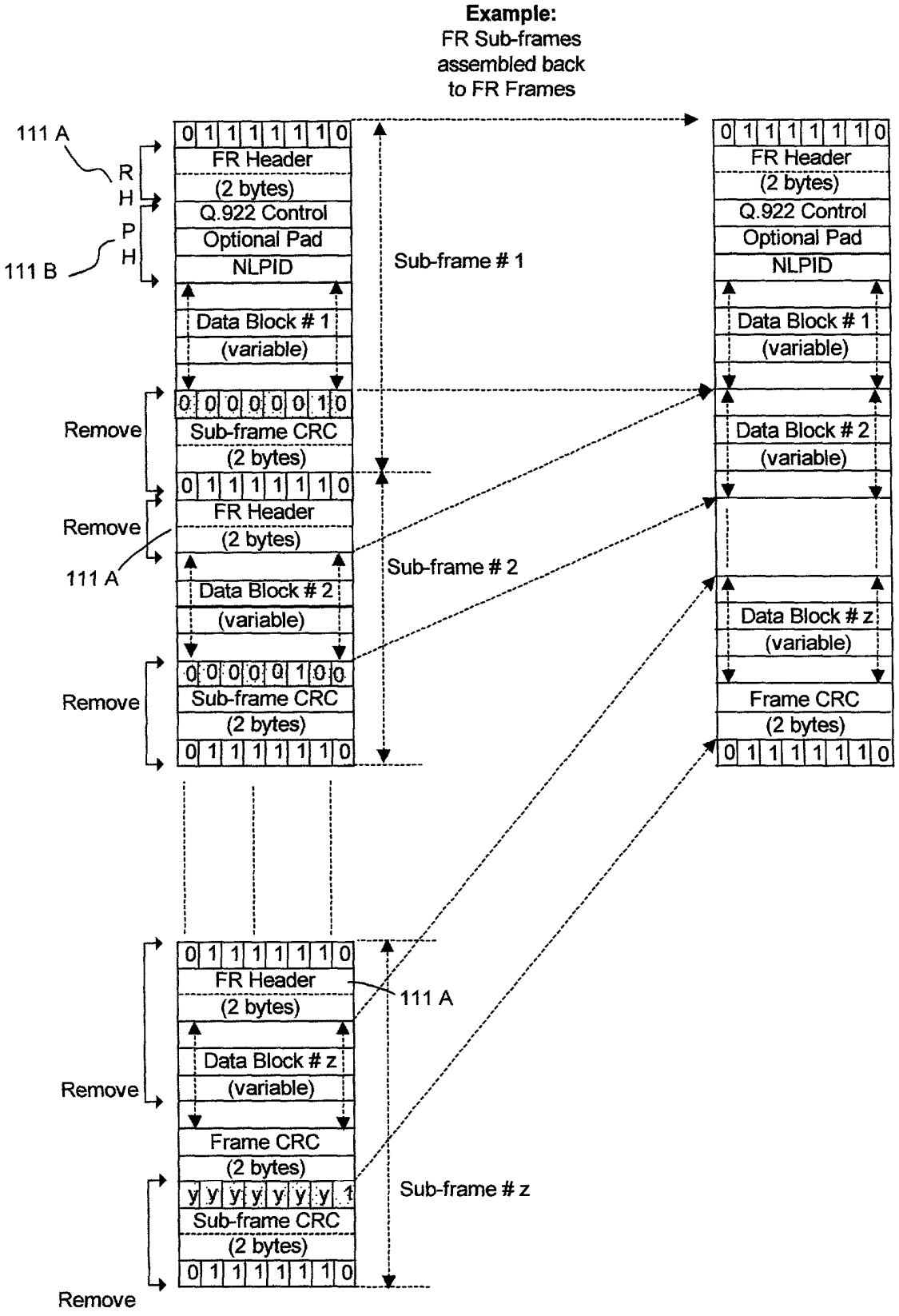

Example:
FR Sub-frames
assembled back
to FR Frames
111 A
RH
PH
111 B
0 1 1 1 1 1 1 0
FR Header
(2 bytes)
Q.922 Control
Optional Pad
NLPID
Data Block # 1
(variable)
Sub-frame # 1
Remove
0 0 0 0 0 0 1 0
Sub-frame CRC
(2 bytes)
0 1 1 1 1 1 1 0
Remove
FR Header
(2 bytes)
111 A
Data Block # 2
(variable)
Sub-frame # 2
Remove
0 0 0 0 0 1 0 0
Sub-frame CRC
(2 bytes)
0 1 1 1 1 1 1 0
Data Block # 2
(variable)
Data Block # z
(variable)
Frame CRC
(2 bytes)
0 1 1 1 1 1 1 0
0 1 1 1 1 1 1 0
FR Header
(2 bytes)
111 A
Remove
Data Block # z
(variable)
Frame CRC
(2 bytes)
y y y y y y y 1
Sub-frame CRC
(2 bytes)
0 1 1 1 1 1 1 0
Sub-frame # z
Remove

FIG. 9

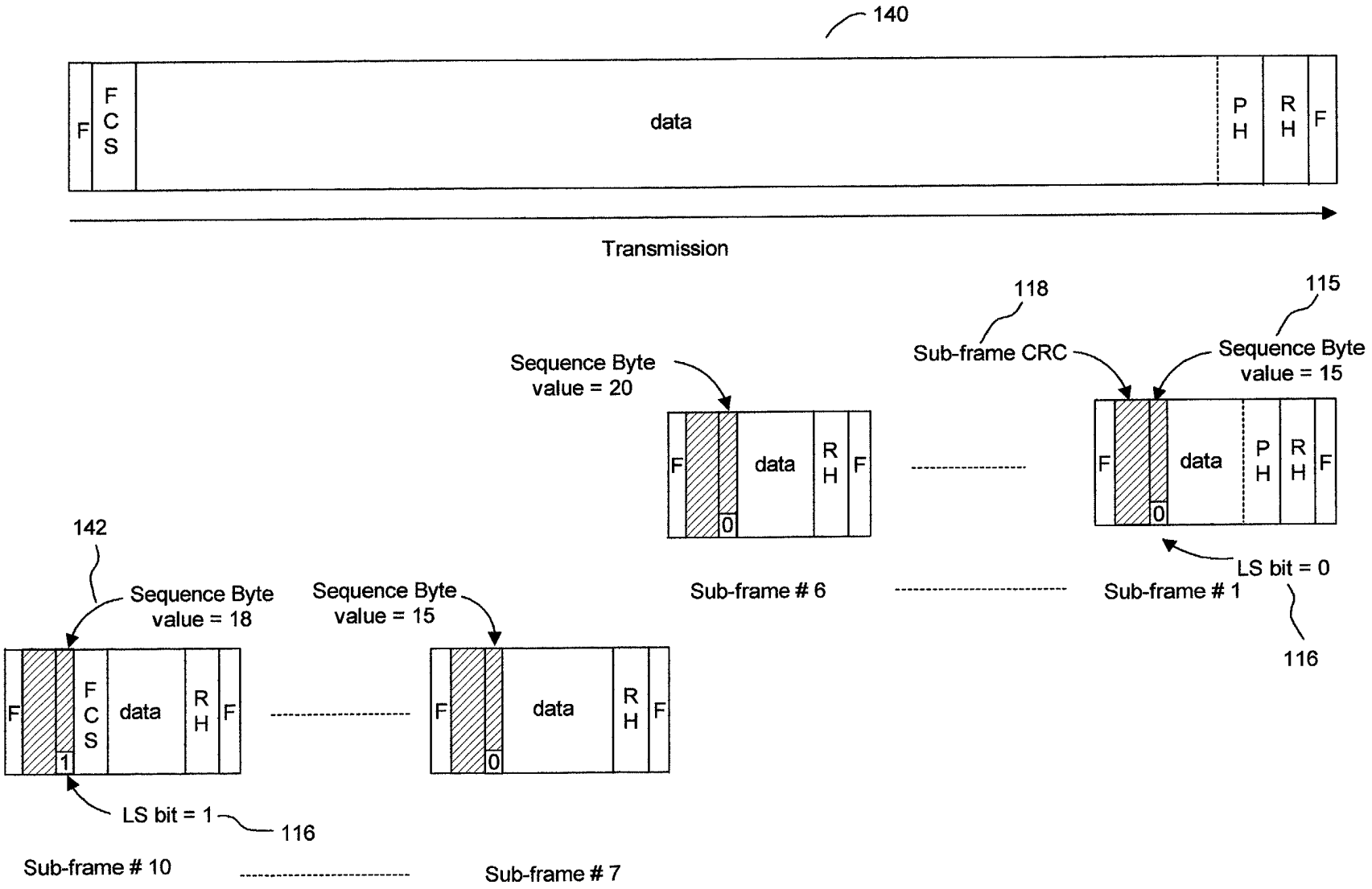

140
F
FCS
data
PH
RH
F
Transmission
118
Sub-frame CRC
115
Sequence Byte value = 15
Sequence Byte value = 20
F
data
RH
F
0
F
data
PH
RH
F
0
LS bit = 0
116
Sub-frame # 6
Sub-frame # 1
142
Sequence Byte value = 18
Sequence Byte value = 15
F
FCS
data
RH
F
1
F
data
RH
F
0
LS bit = 1
116
Sub-frame # 10
Sub-frame # 7

FIG. 10

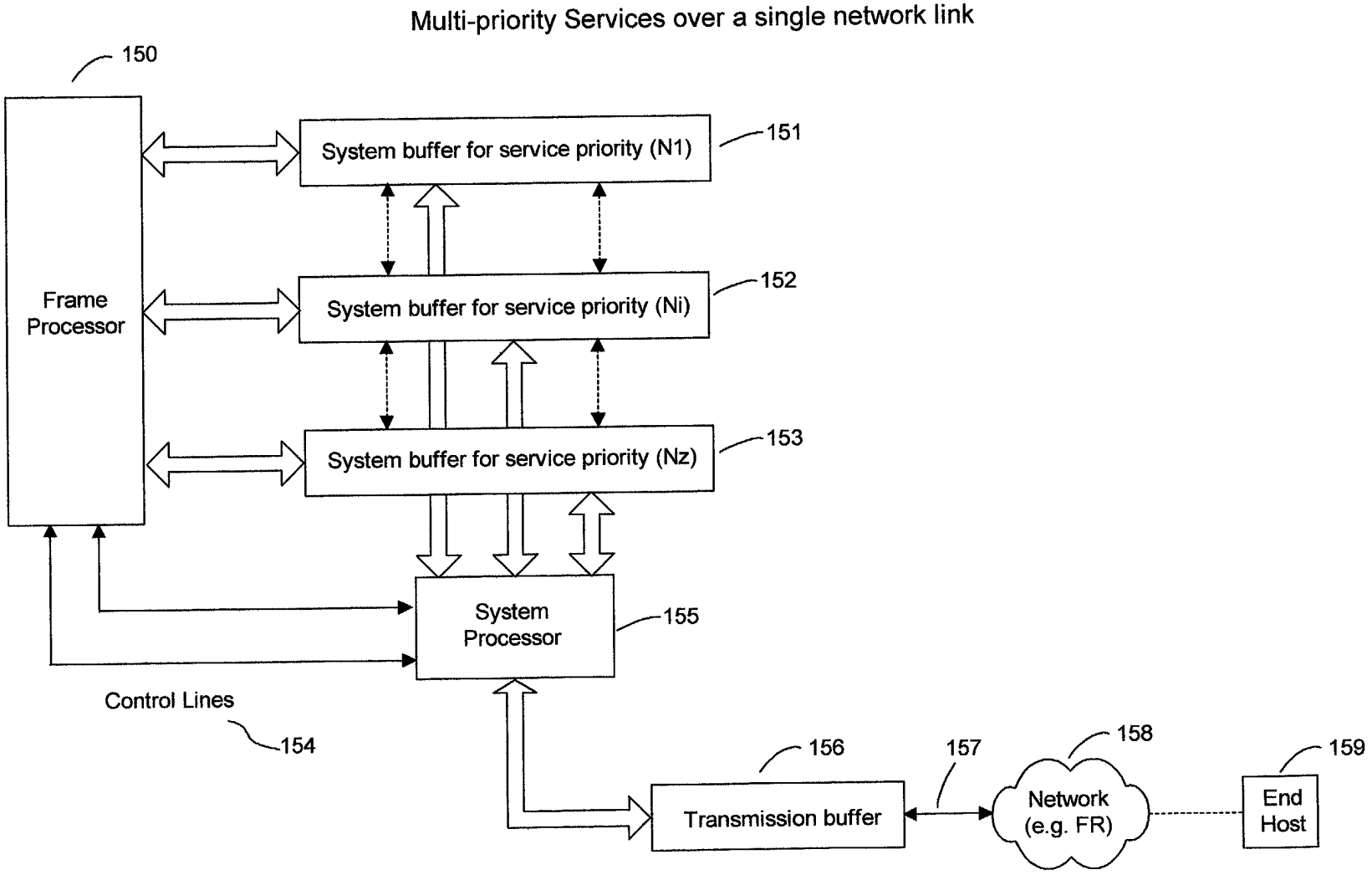

Multi-priority Services over a single network link
150
Frame Processor
System buffer for service priority (N1)
151
System buffer for service priority (Ni)
152
System buffer for service priority (Nz)
153
System Processor
155
Control Lines
154
156
Transmission buffer
157
158
Network (e.g. FR)
159
End Host

FIG. 11

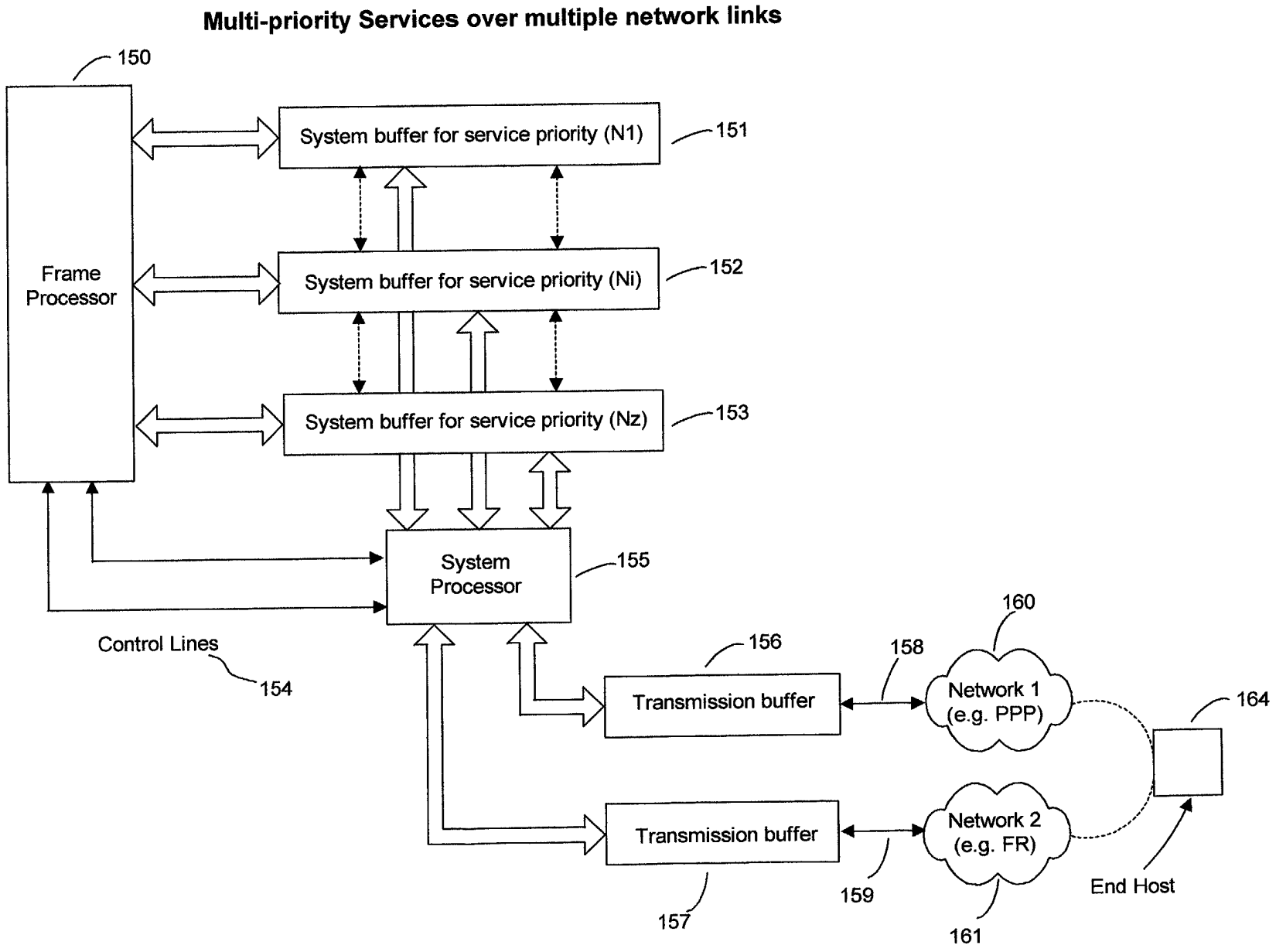

Multi-priority Services over multiple network links
150
Frame Processor
System buffer for service priority (N1)
151
System buffer for service priority (Ni)
152
System buffer for service priority (Nz)
153
System Processor
155
Control Lines
154
156
Transmission buffer
158
160
Network 1 (e.g. PPP)
164
Transmission buffer
Network 2 (e.g. FR)
End Host
157
159
161

FIG. 12

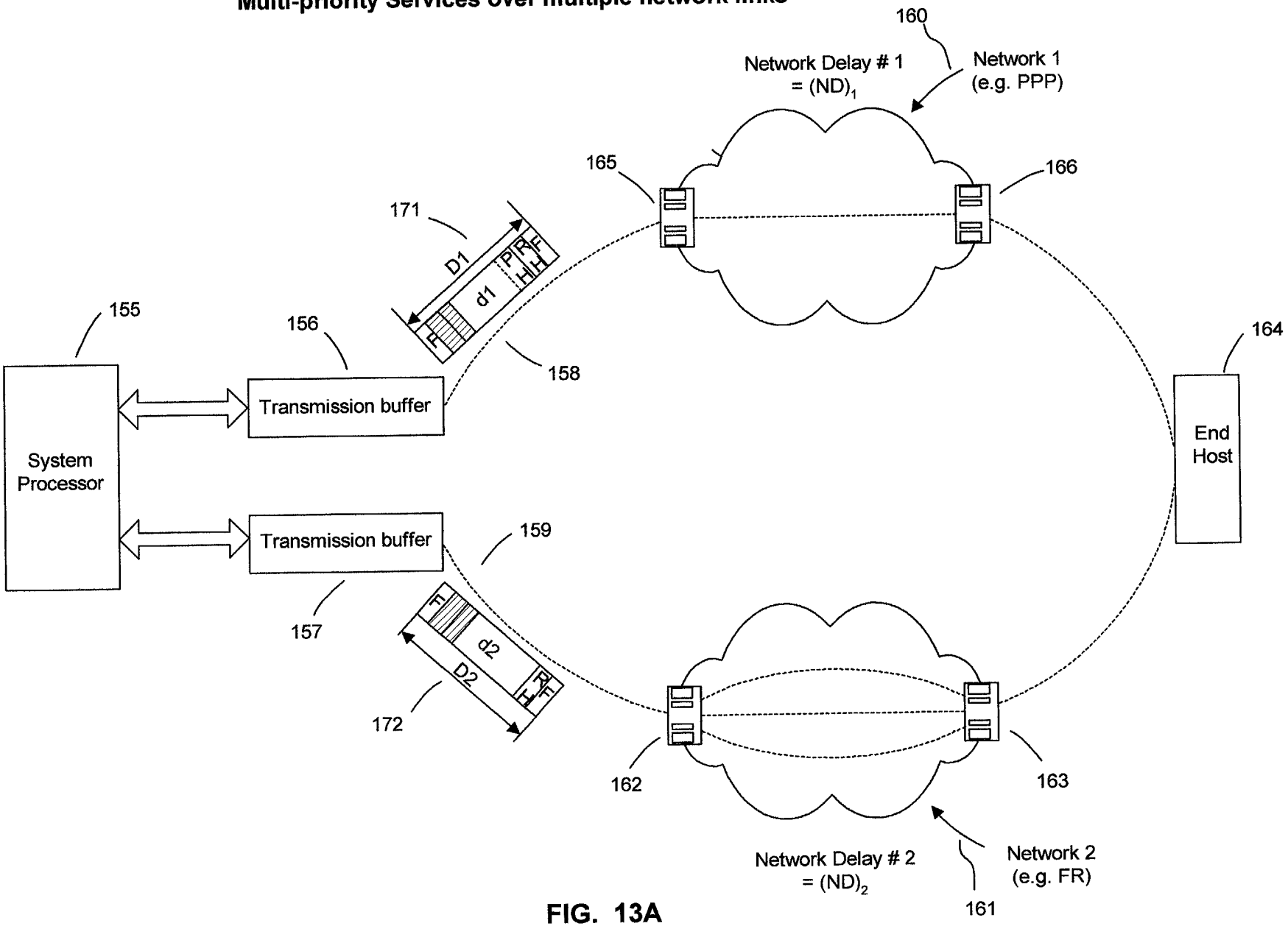

Multi-priority Services over multiple network links
160
Network Delay # 1
= (ND)1
Network 1
(e.g. PPP)
165
166
171
D1
d1
P
RH
H
155
156
158
164
Transmission buffer
System
Processor
End
Host
Transmission buffer
159
157
d2
D2
RH
H
172
162
163
Network Delay # 2
= (ND)2
Network 2
(e.g. FR)
161

FIG. 13A

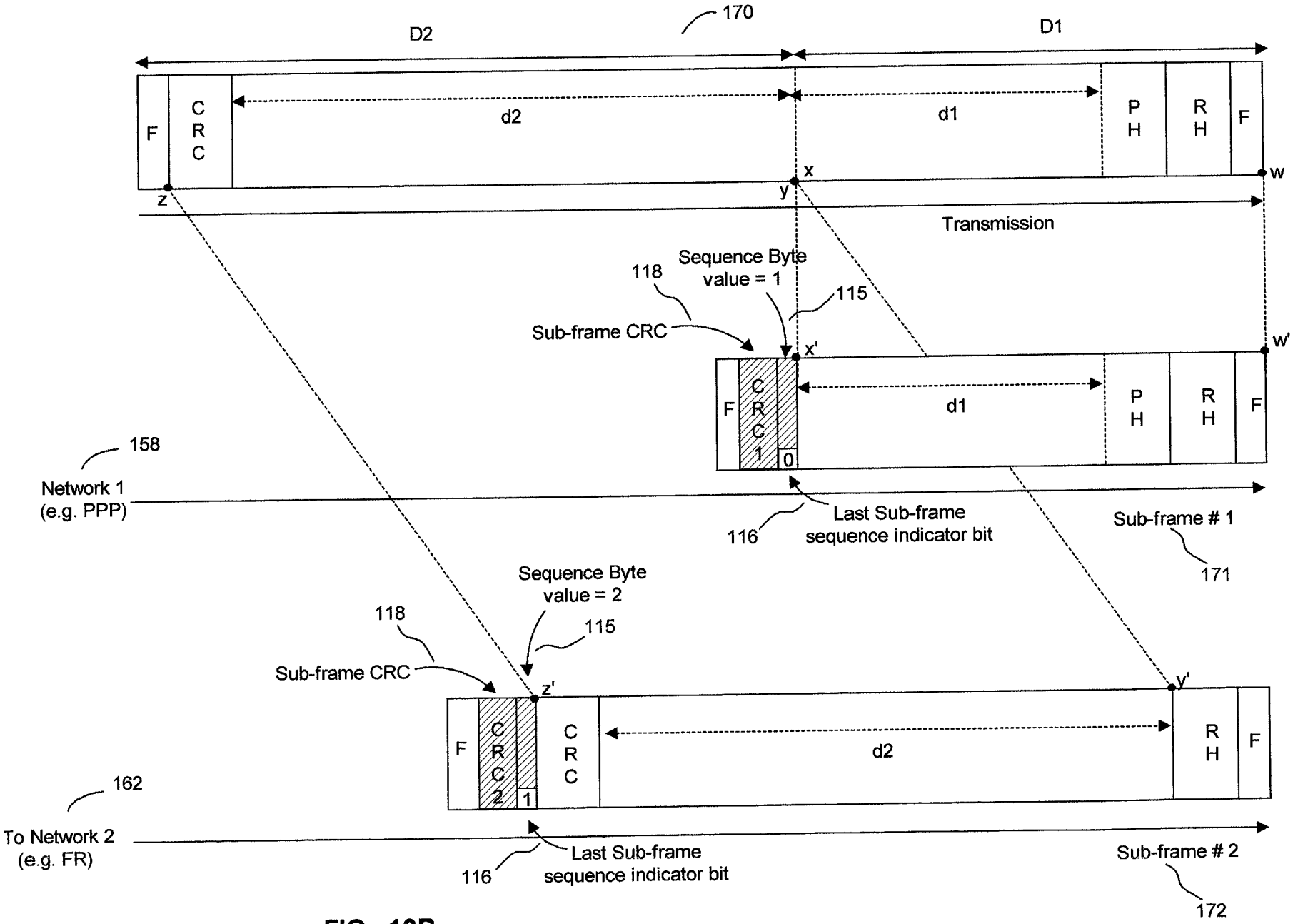

170
D2
D1
F
C
R
C
d2
d1
P
H
R
H
F
x
w
z
y
Transmission
118
Sequence Byte
value = 1
115
Sub-frame CRC
x'
w'
F
C
R
C
1
0
d1
P
H
R
H
F
158
Network 1
(e.g. PPP)
116
Last Sub-frame
sequence indicator bit
Sub-frame # 1
171
Sequence Byte
value = 2
118
115
Sub-frame CRC
z'
y'
F
C
R
C
2
1
C
R
C
d2
R
H
F
162
To Network 2
(e.g. FR)
116
Last Sub-frame
sequence indicator bit
Sub-frame # 2
172

FIG. 13B

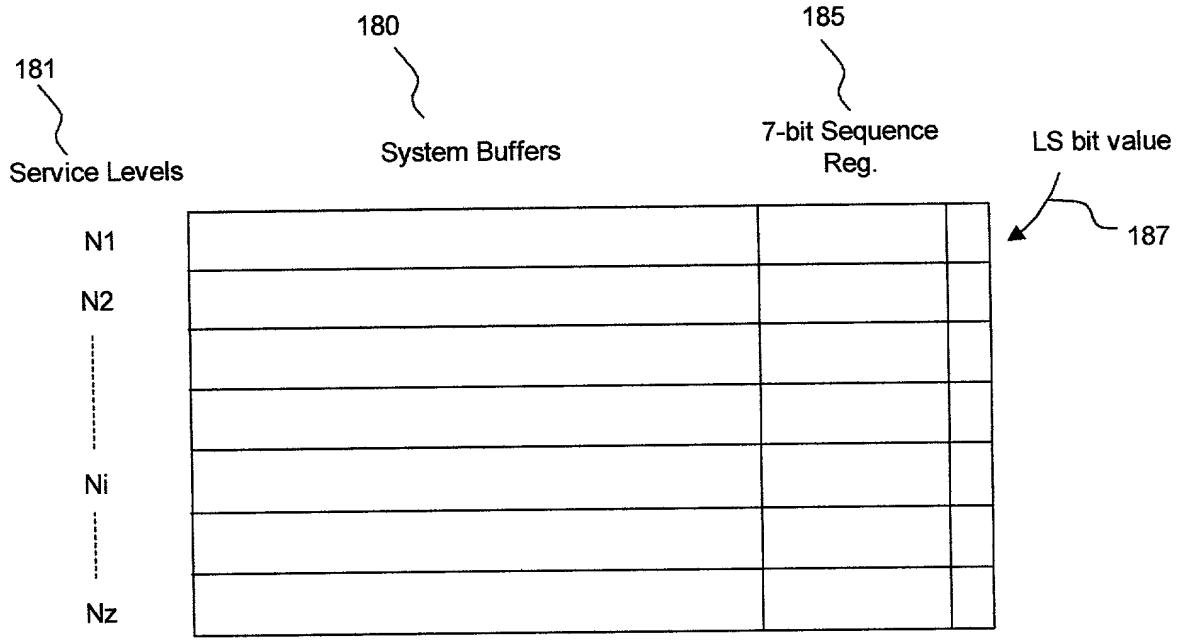


FIG. 14A

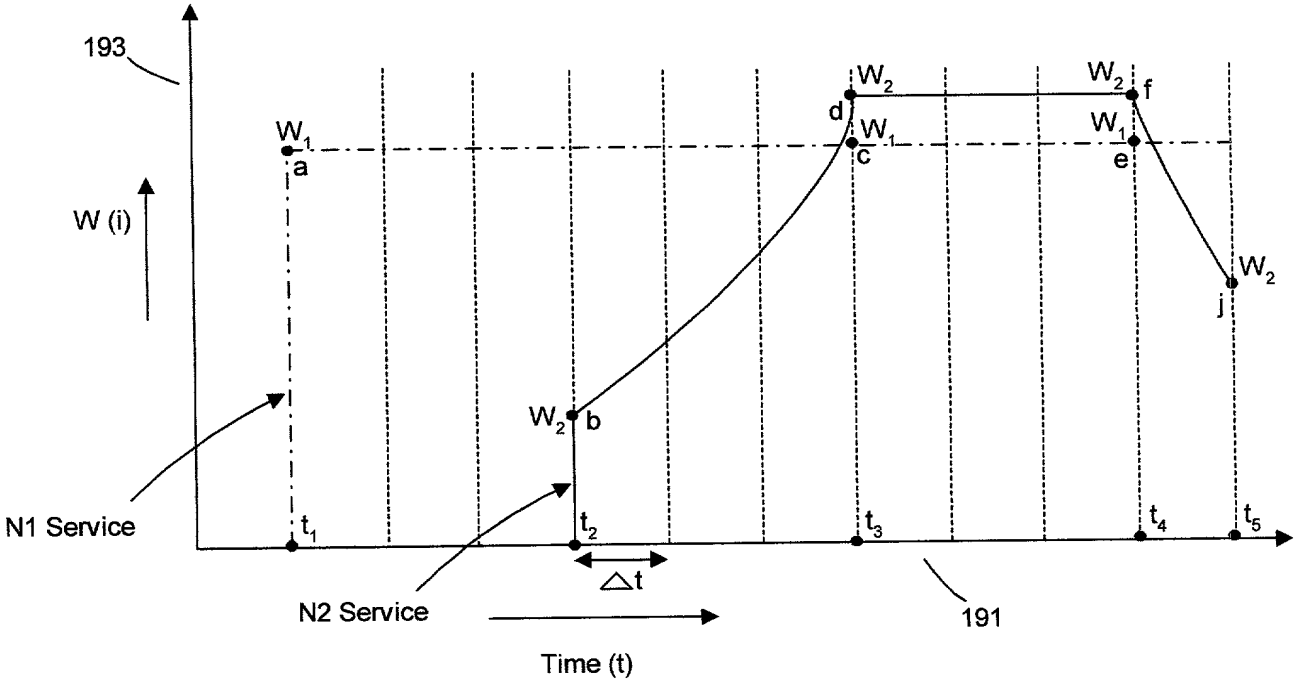


FIG. 14B

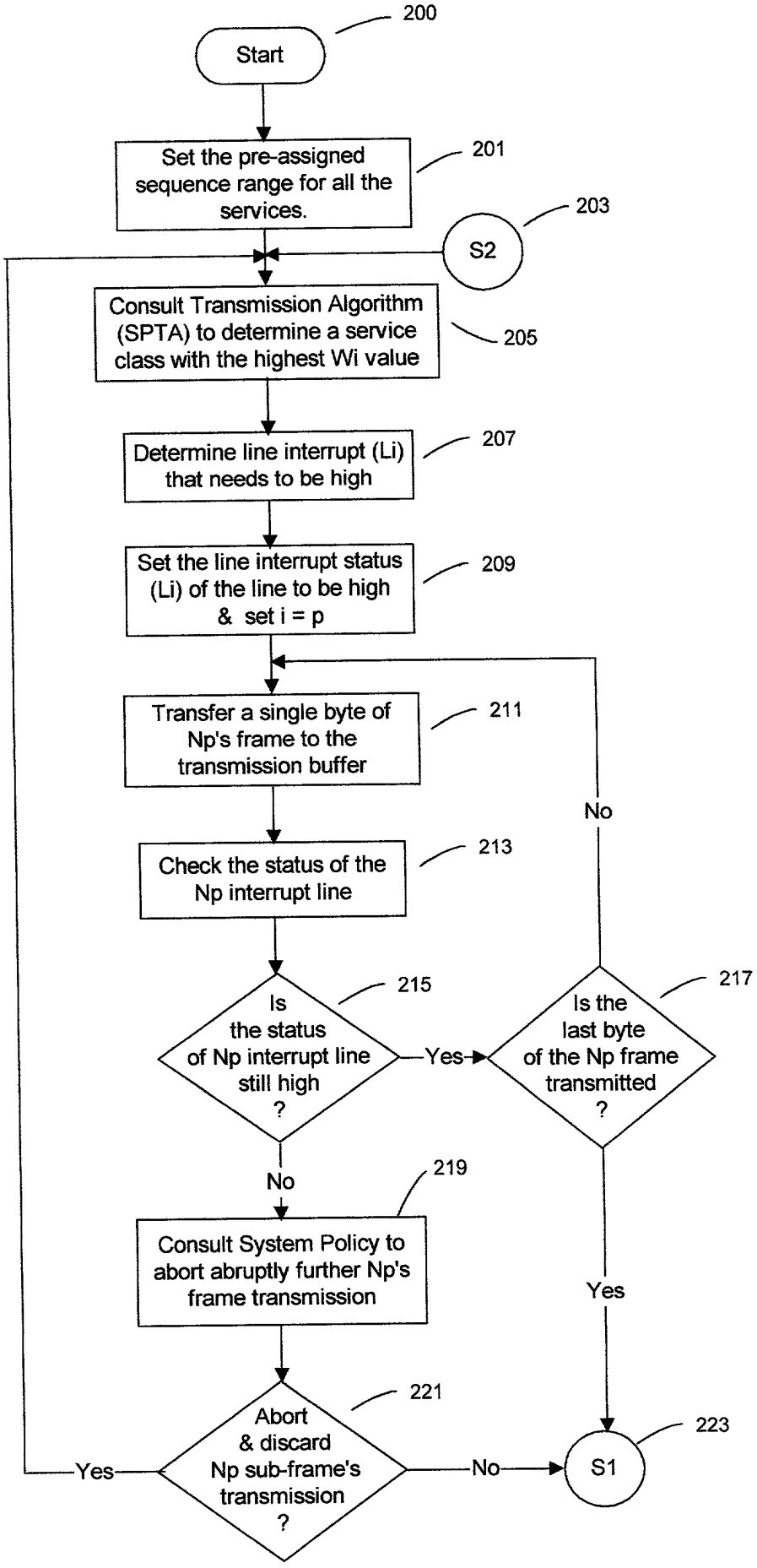

200
Start
Set the pre-assigned sequence range for all the services.
201
203
S2
Consult Transmission Algorithm (SPTA) to determine a service class with the highest Wi value
205
Determine line interrupt (Li) that needs to be high
207
Set the line interrupt status (Li) of the line to be high & set i = p
209
Transfer a single byte of Np's frame to the transmission buffer
211
Check the status of the Np interrupt line
213
Is the status of Np interrupt line still high ?
215
Yes
Is the last byte of the Np frame transmitted ?
217
No
No
Consult System Policy to abort abruptly further Np's frame transmission
219
Yes
Abort & discard Np sub-frame's transmission ?
221
Yes
No
S1
223

FIG. 15A

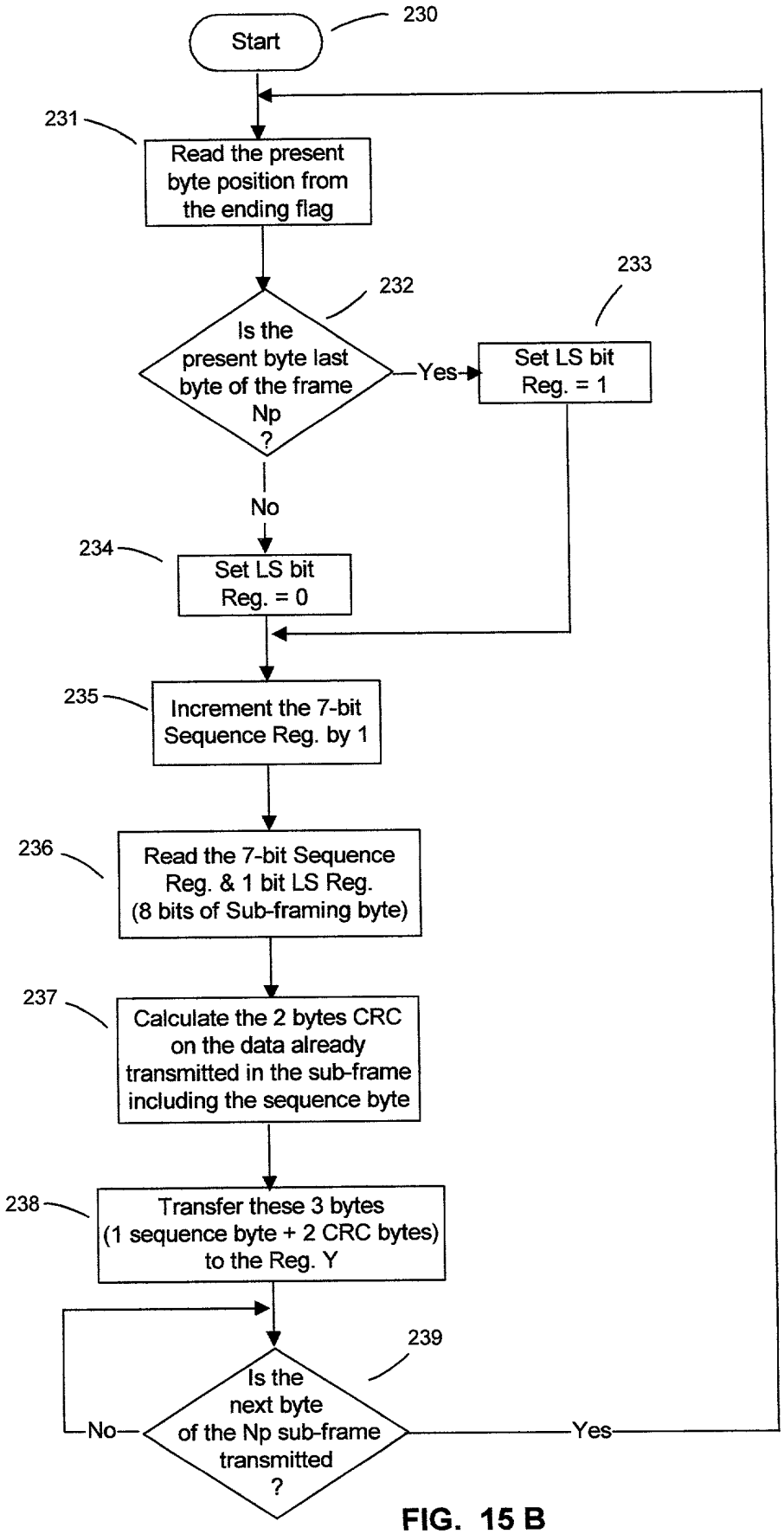

Start
230
231
Read the present byte position from the ending flag
232
Is the present byte last byte of the frame Np ?
Yes
233
Set LS bit Reg. = 1
No
234
Set LS bit Reg. = 0
235
Increment the 7-bit Sequence Reg. by 1
236
Read the 7-bit Sequence Reg. & 1 bit LS Reg. (8 bits of Sub-framing byte)
237
Calculate the 2 bytes CRC on the data already transmitted in the sub-frame including the sequence byte
238
Transfer these 3 bytes (1 sequence byte + 2 CRC bytes) to the Reg. Y
239
Is the next byte of the Np sub-frame transmitted ?
No
Yes

FIG. 15 B

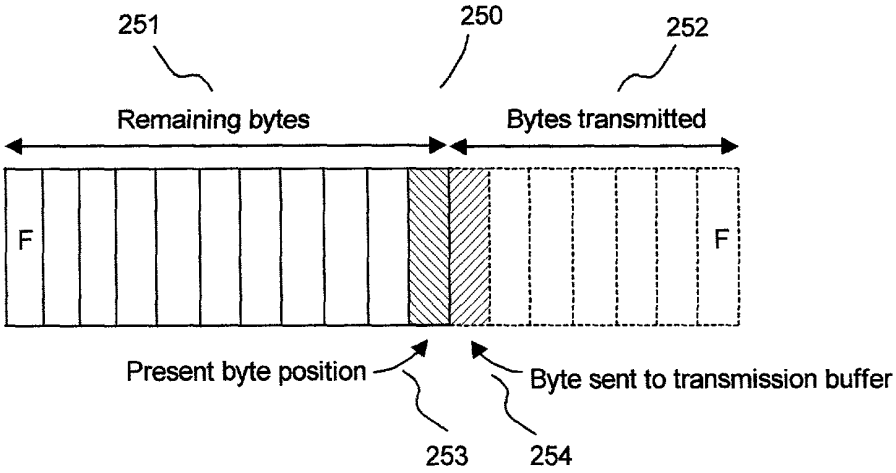


FIG. 15C

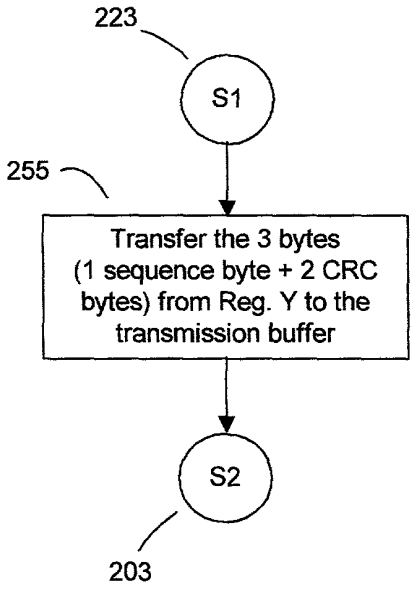


FIG. 15D

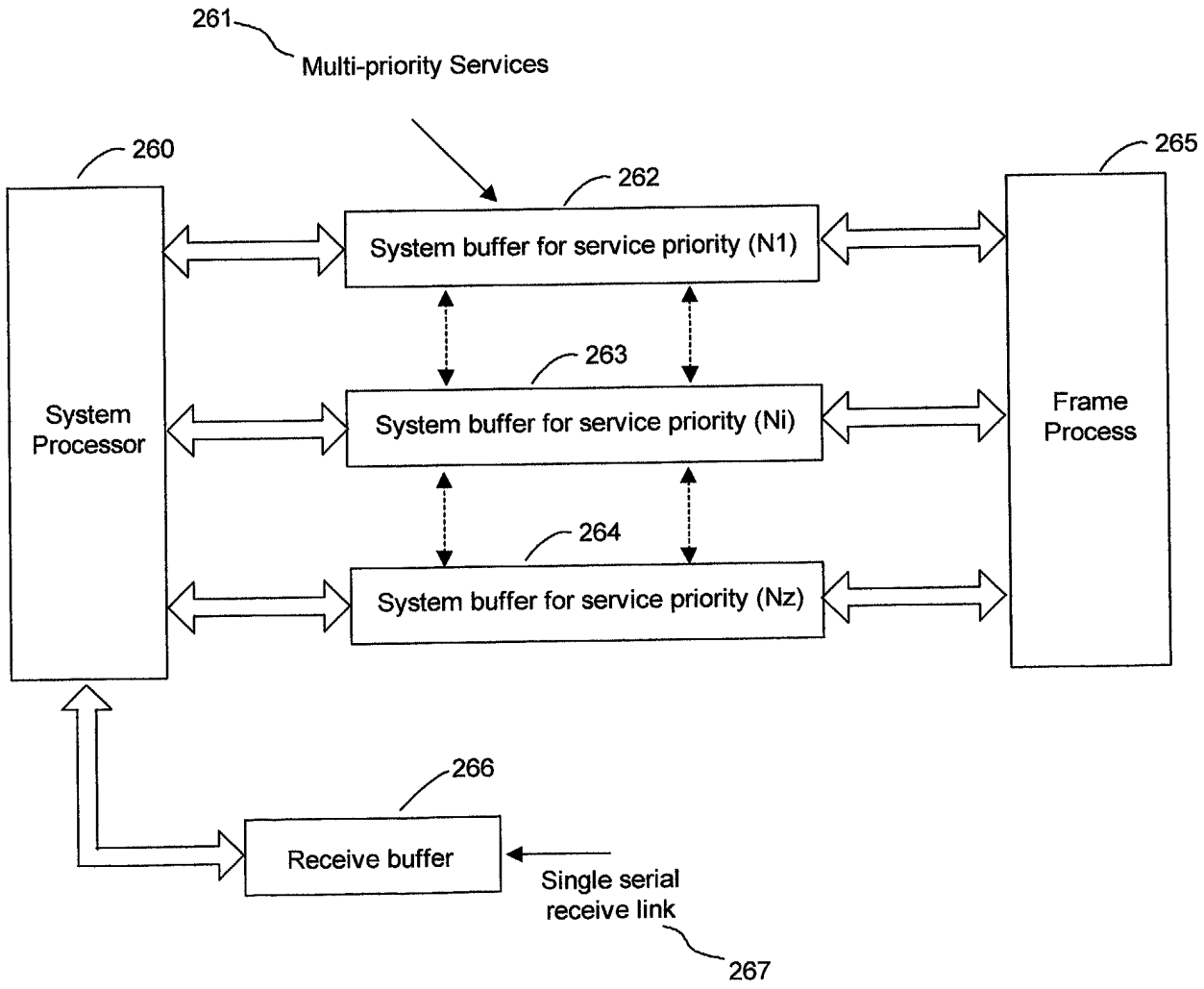

261
Multi-priority Services
260
262
265
System buffer for service priority (N1)
263
System Processor
System buffer for service priority (Ni)
Frame Process
264
System buffer for service priority (Nz)
266
Receive buffer
Single serial receive link
267

FIG. 16A

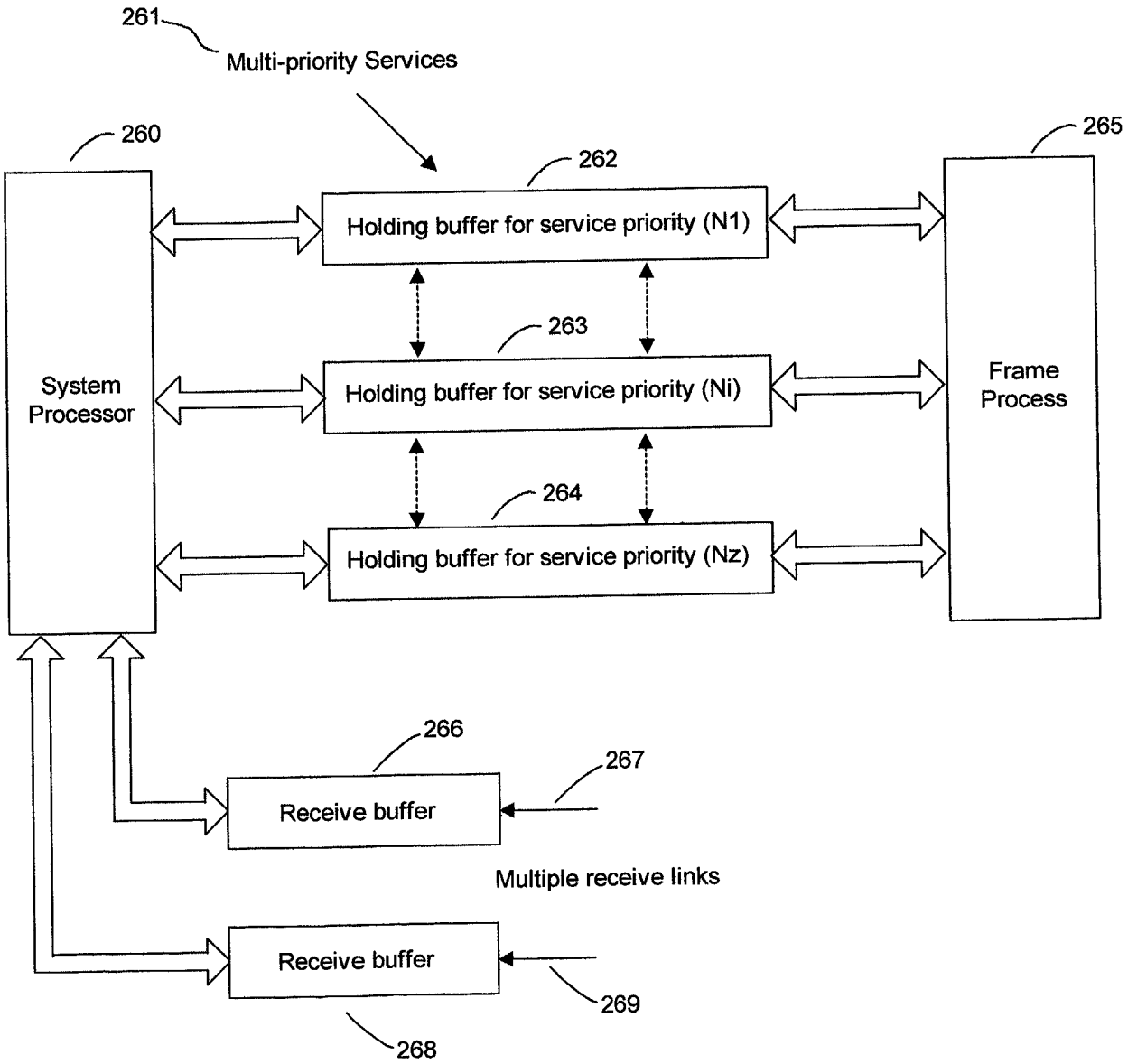

261
Multi-priority Services
260
262
265
Holding buffer for service priority (N1)
263
System Processor
Holding buffer for service priority (Ni)
Frame Process
264
Holding buffer for service priority (Nz)
266
267
Receive buffer
Multiple receive links
Receive buffer
269
268

FIG. 16B

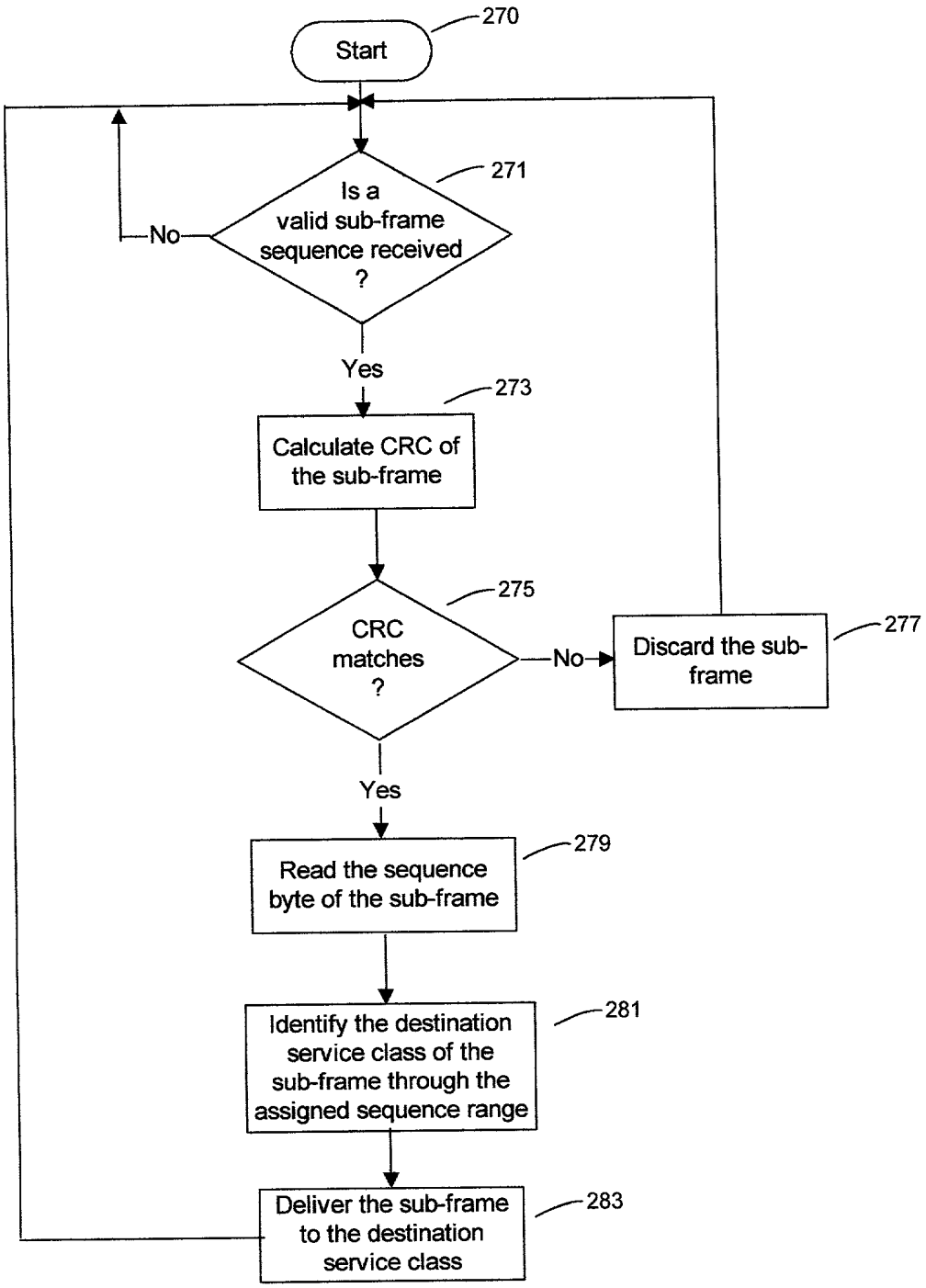

Start
270
Is a valid sub-frame sequence received ?
271
No
Yes
Calculate CRC of the sub-frame
273
CRC matches ?
275
No
Discard the sub-frame
277
Yes
Read the sequence byte of the sub-frame
279
Identify the destination service class of the sub-frame through the assigned sequence range
281
Deliver the sub-frame to the destination service class
283

FIG. 17

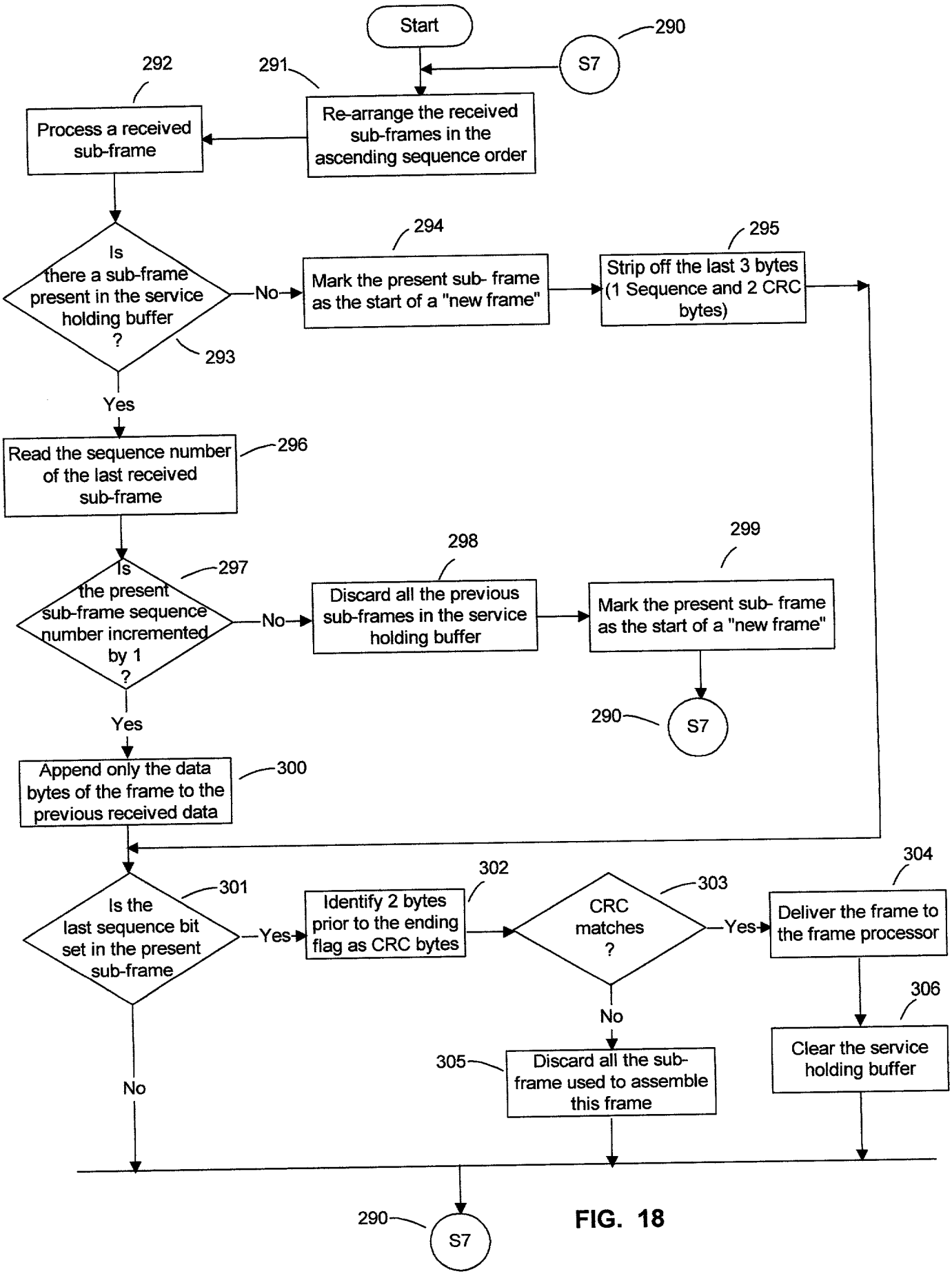

Start
290
S7
291
292
Re-arrange the received sub-frames in the ascending sequence order
Process a received sub-frame
Is there a sub-frame present in the service holding buffer ?
293
No
294
Mark the present sub- frame as the start of a "new frame"
295
Strip off the last 3 bytes (1 Sequence and 2 CRC bytes)
Yes
Read the sequence number of the last received sub-frame
296
Is the present sub-frame sequence number incremented by 1 ?
297
No
298
Discard all the previous sub-frames in the service holding buffer
299
Mark the present sub- frame as the start of a "new frame"
290
S7
Yes
Append only the data bytes of the frame to the previous received data
300
Is the last sequence bit set in the present sub-frame
301
Yes
302
Identify 2 bytes prior to the ending flag as CRC bytes
CRC matches ?
303
Yes
304
Deliver the frame to the frame processor
306
Clear the service holding buffer
No
305
Discard all the sub-frame used to assemble this frame
No
290
S7

FIG. 18

Multi-priority Services over multiple links

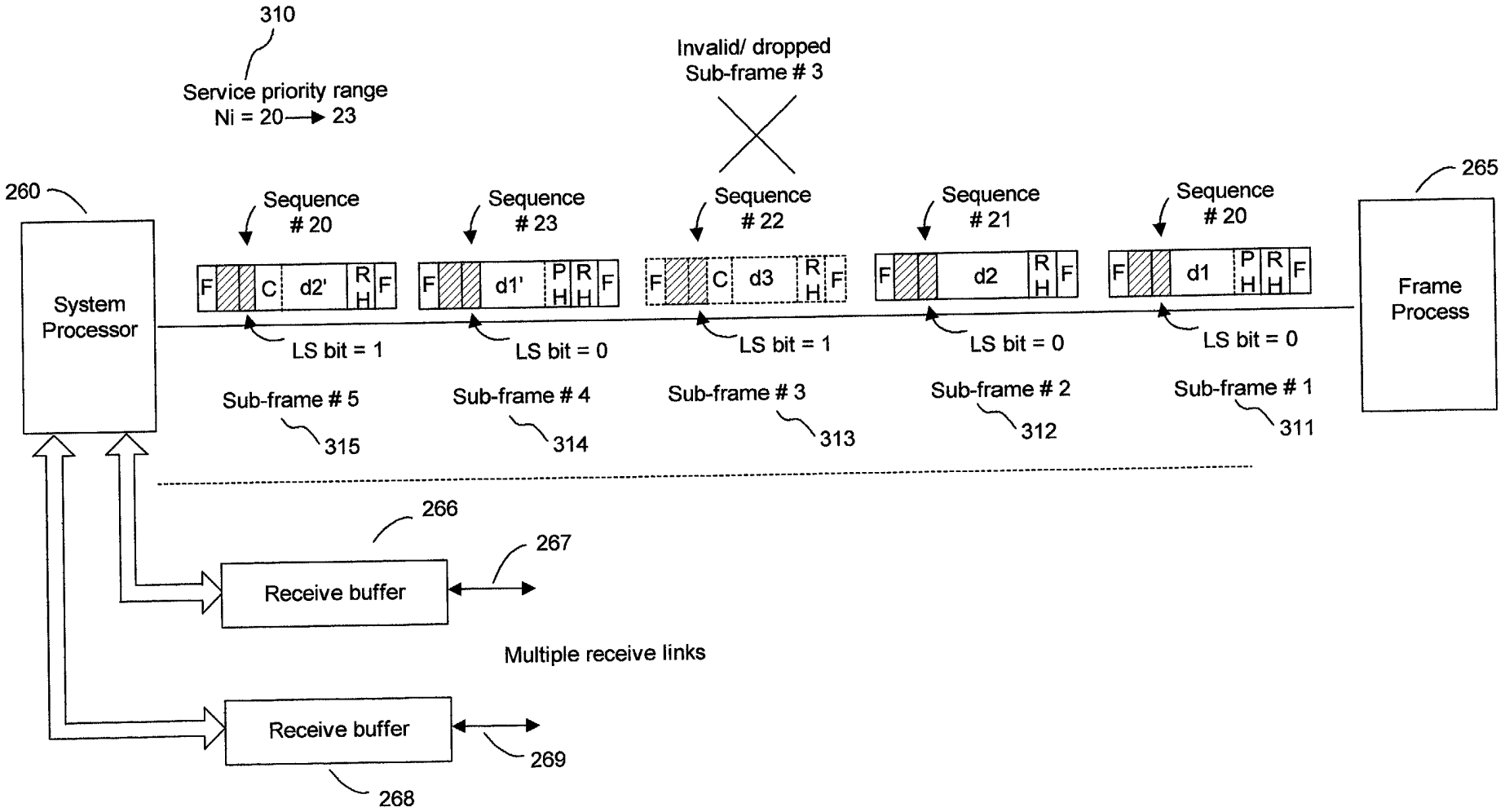


FIG. 19A

Multi-priority Services over a single link

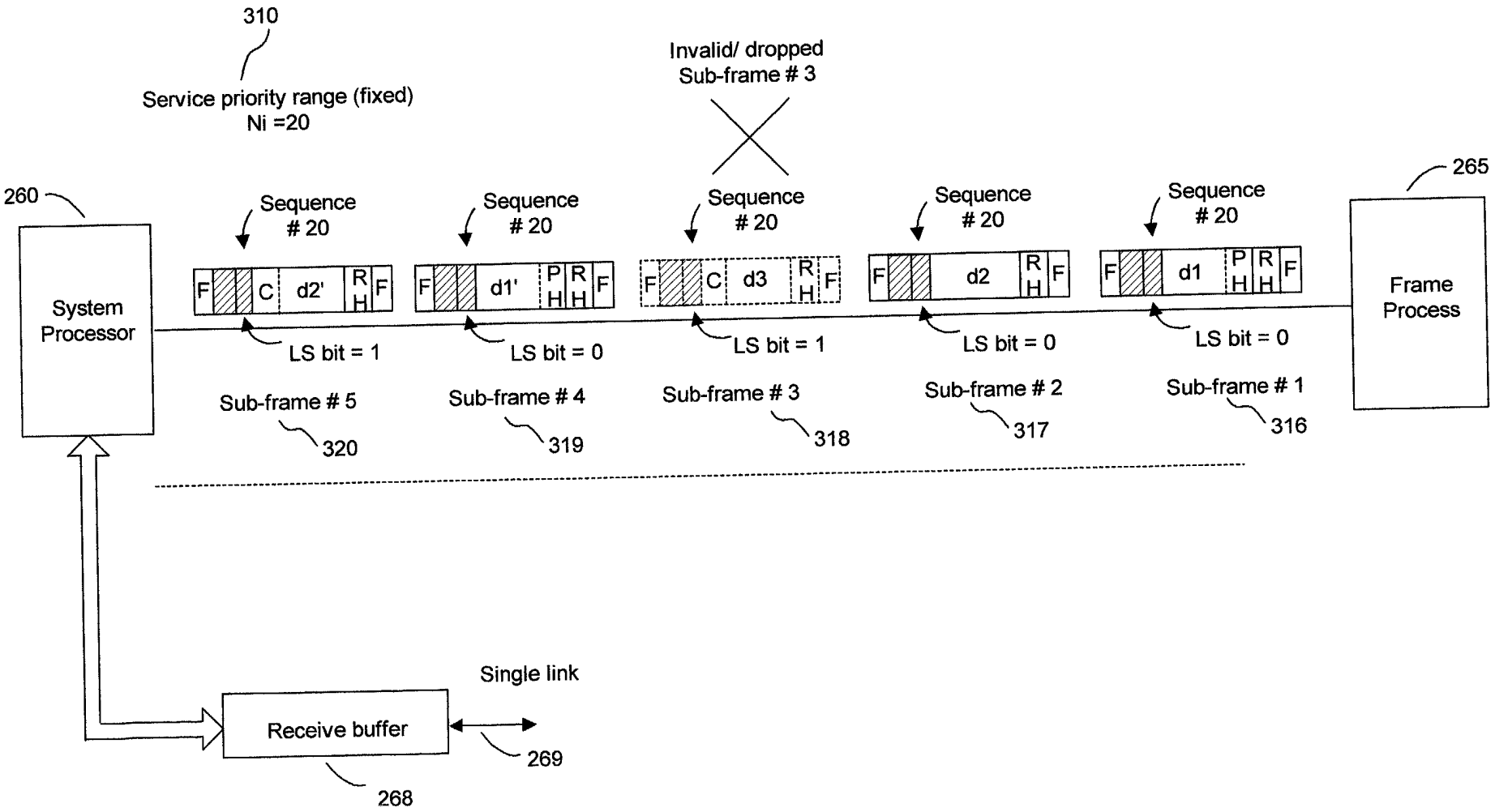


FIG. 19B

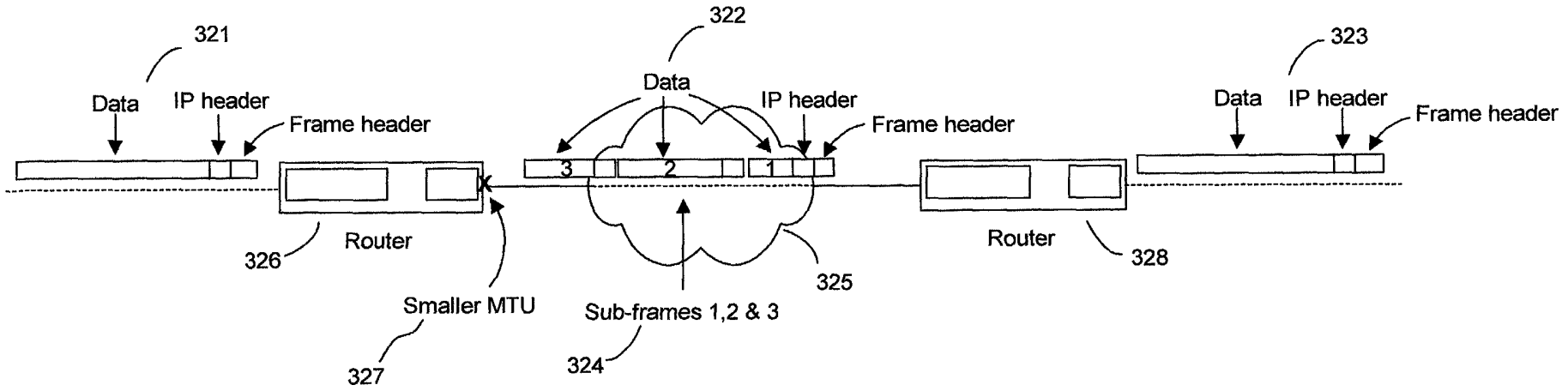


FIG. 20A

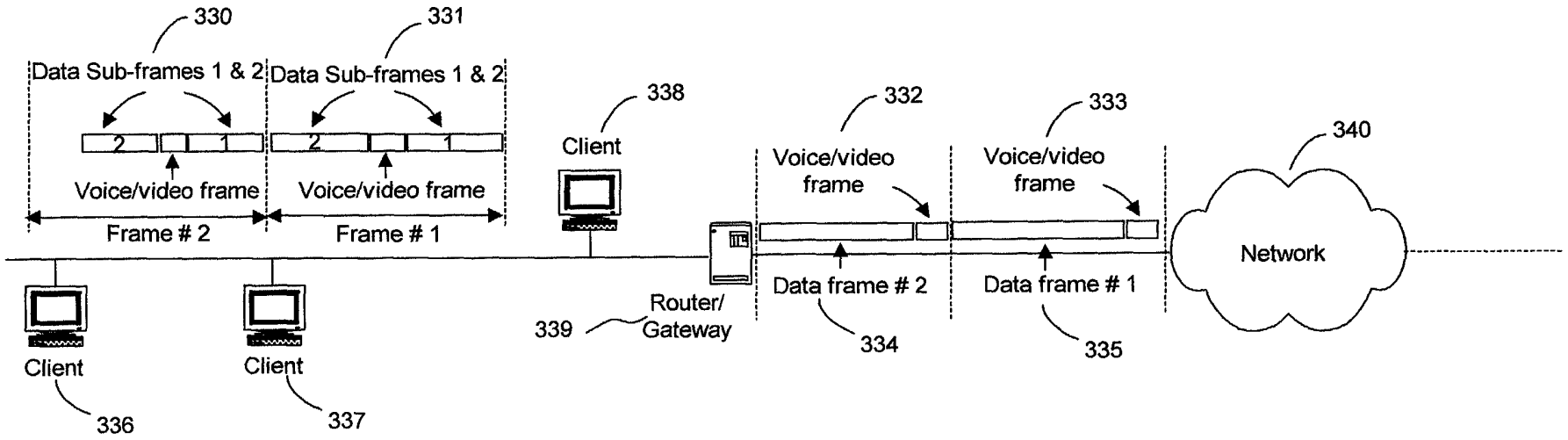


FIG. 20B

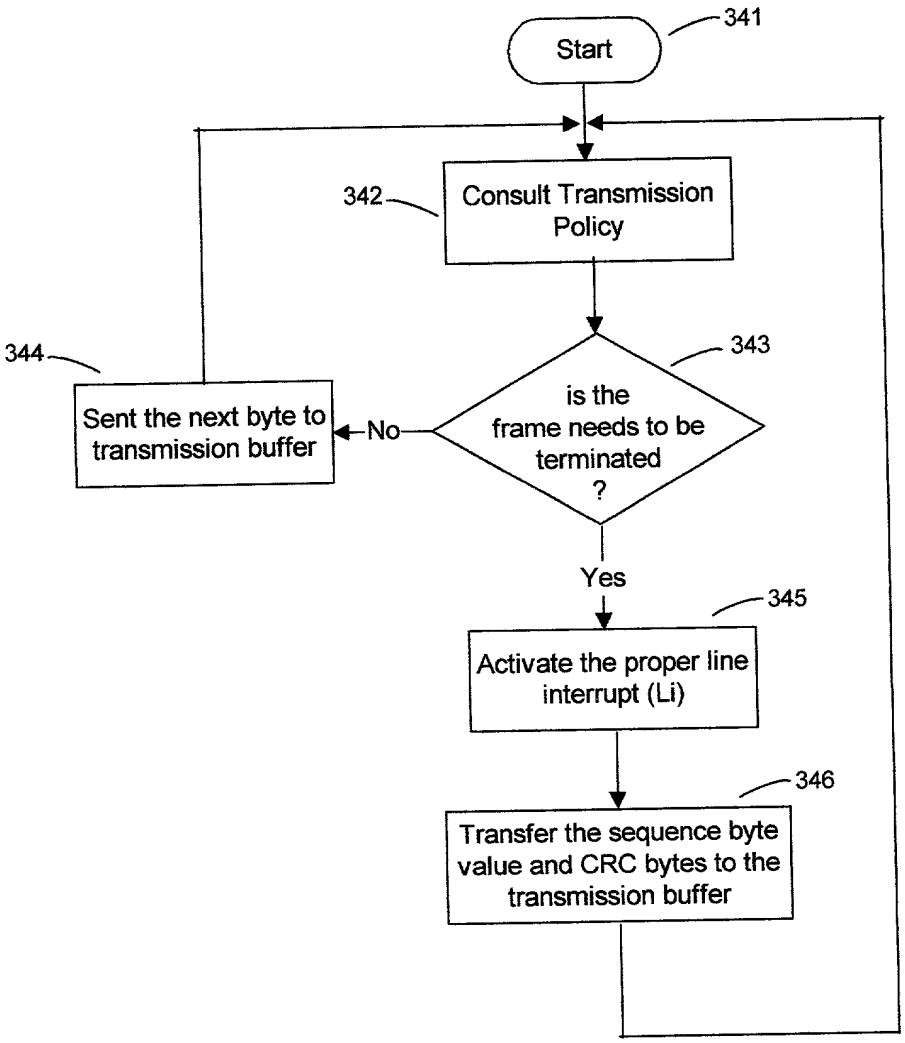

Start
341
Consult Transmission Policy
342
is the frame needs to be terminated ?
343
No
Sent the next byte to transmission buffer
344
Yes
Activate the proper line interrupt (Li)
345
Transfer the sequence byte value and CRC bytes to the transmission buffer
346

FIG. 21

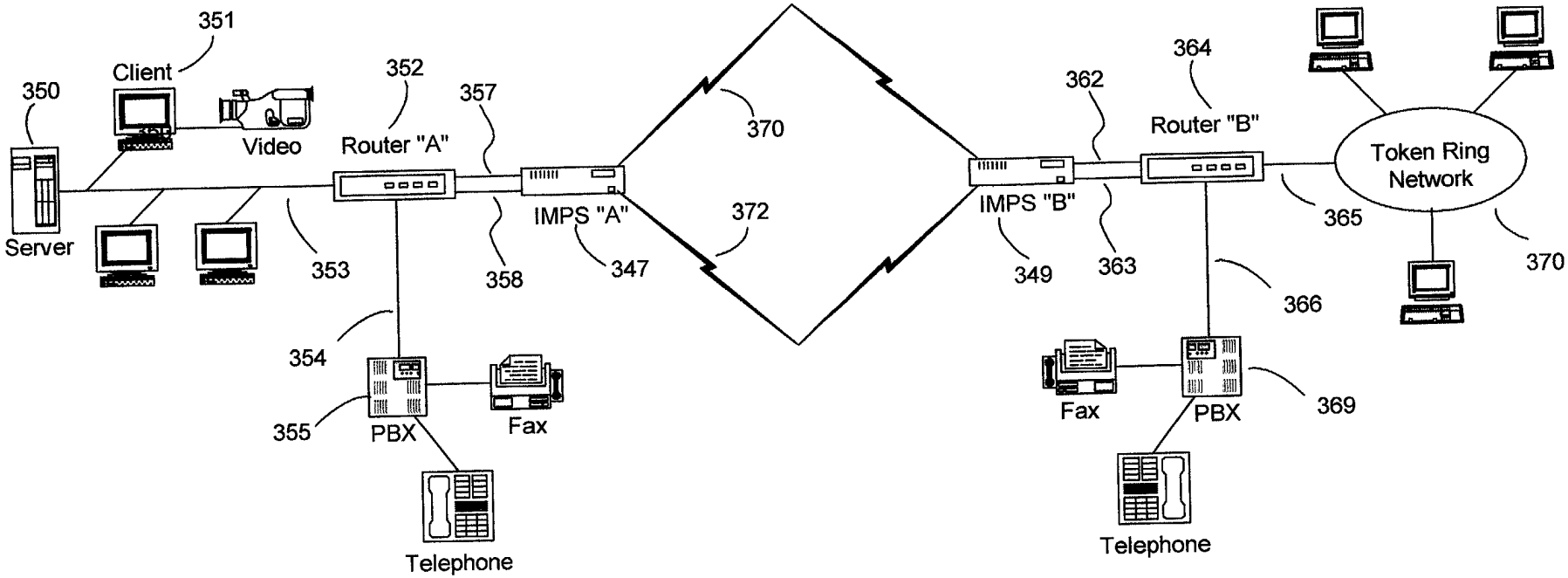

351
Client
350
Video
352
Router "A"
357
370
364
362
Router "B"
Token Ring
Network
Server
353
358
IMPS "A"
372
347
IMPS "B"
349
363
365
370
366
354
355
PBX
Fax
Fax
PBX
369
Telephone
Telephone
Network "Y"
Network "Z"

FIG. 22

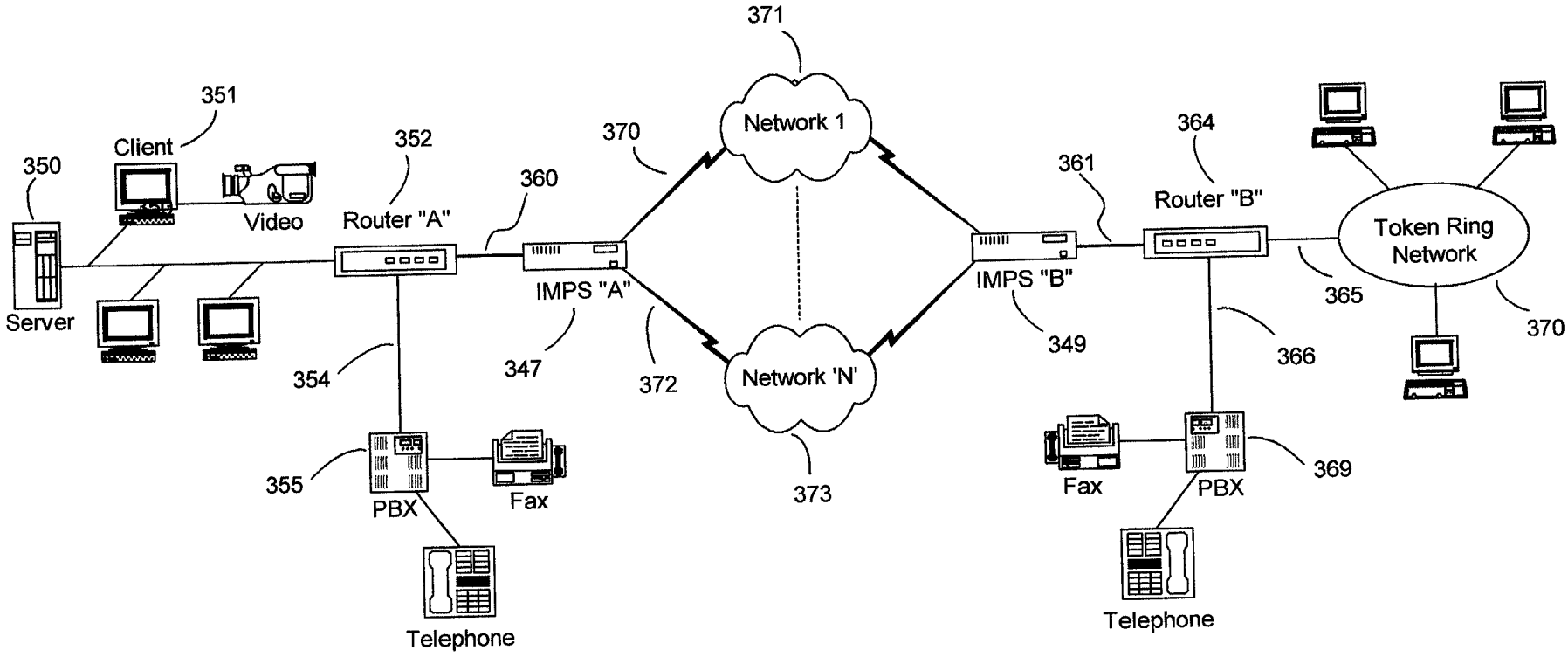

371
Network 1
370
351
Client
350
352
Router "A"
360
Video
Server
IMPS "A"
347
354
372
Network 'N'
373
355
PBX
Fax
Telephone
Network "Y"
361
364
Router "B"
IMPS "B"
349
366
Token Ring
Network
365
370
Fax
PBX
369
Telephone
Network "Z"

FIG. 23

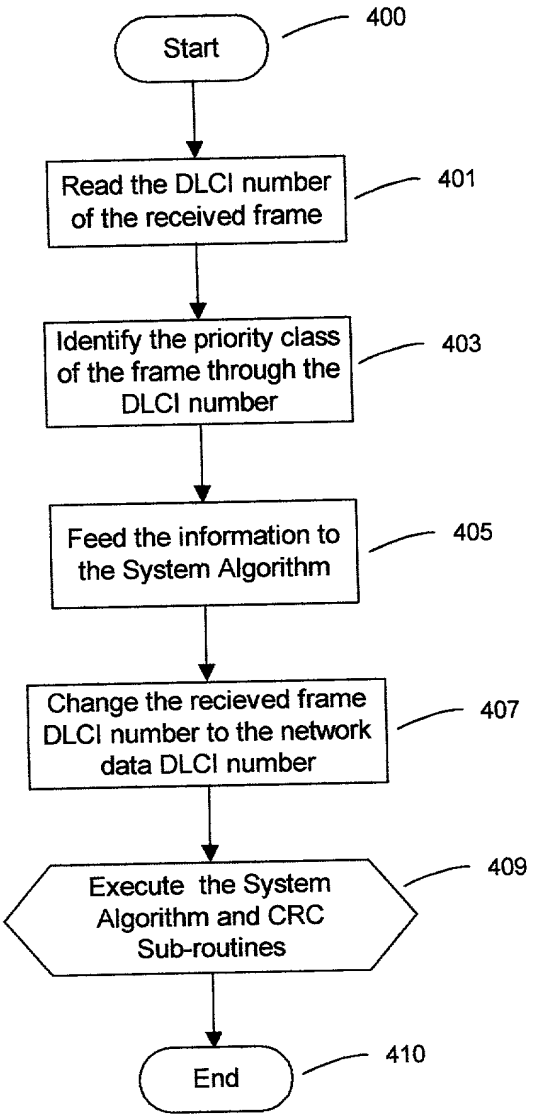

Start
400
Read the DLCI number of the received frame
401
Identify the priority class of the frame through the DLCI number
403
Feed the information to the System Algorithm
405
Change the recieved frame DLCI number to the network data DLCI number
407
Execute the System Algorithm and CRC Sub-routines
409
End
410

FIG. 24

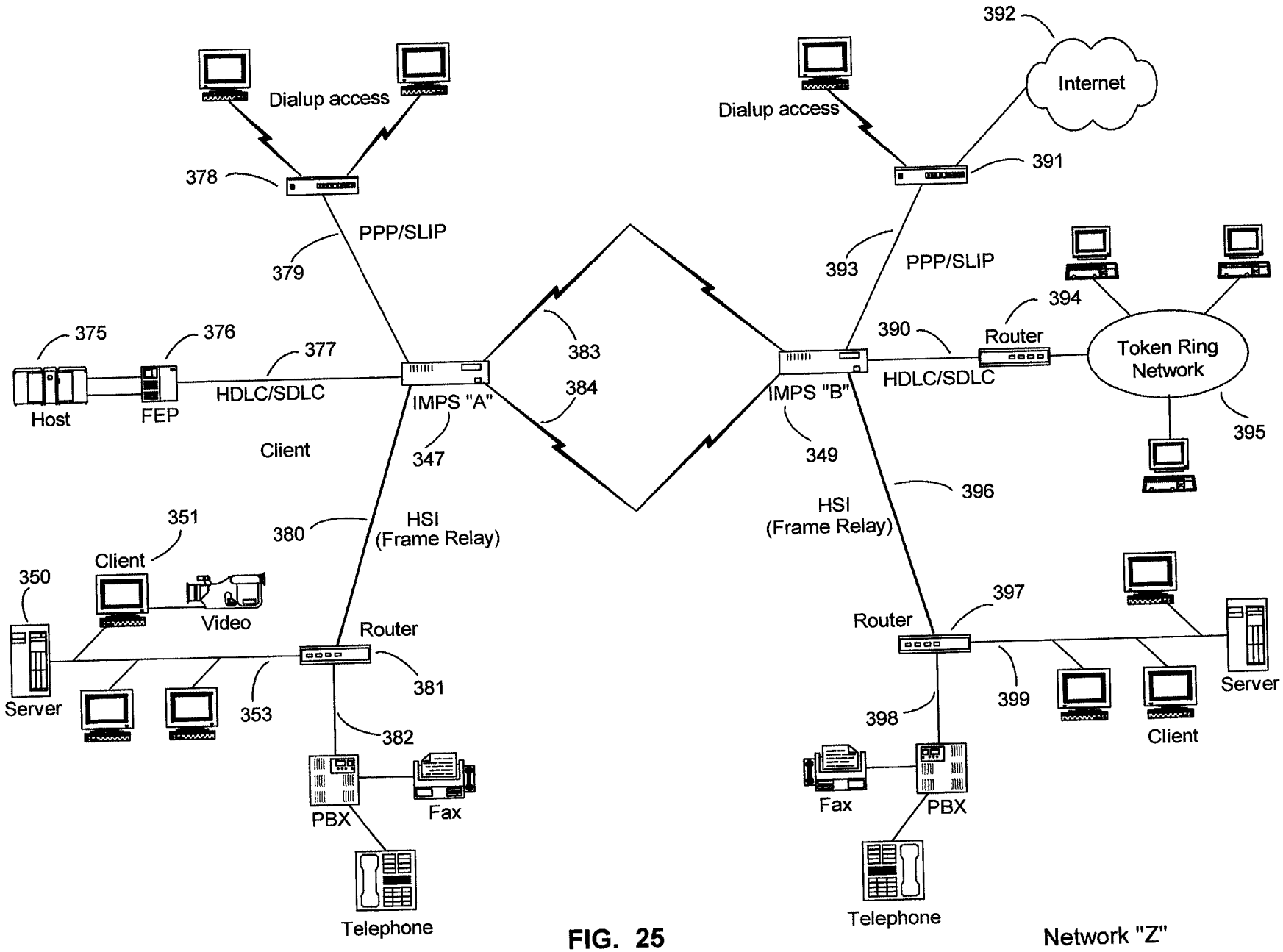

Dialup access
378
PPP/SLIP
379
375
376
377
HDLC/SDLC
Host
FEP
Client
IMPS "A"
347
383
384
380
HSI
(Frame Relay)
351
Client
350
Video
Router
381
Server
353
382
PBX
Fax
Telephone
Network "Y"
392
Internet
Dialup access
391
393
PPP/SLIP
394
390
Router
Token Ring
Network
395
HDLC/SDLC
IMPS "B"
349
396
HSI
(Frame Relay)
397
Router
Server
399
398
Client
Fax
PBX
Telephone
Network "Z"

FIG. 25

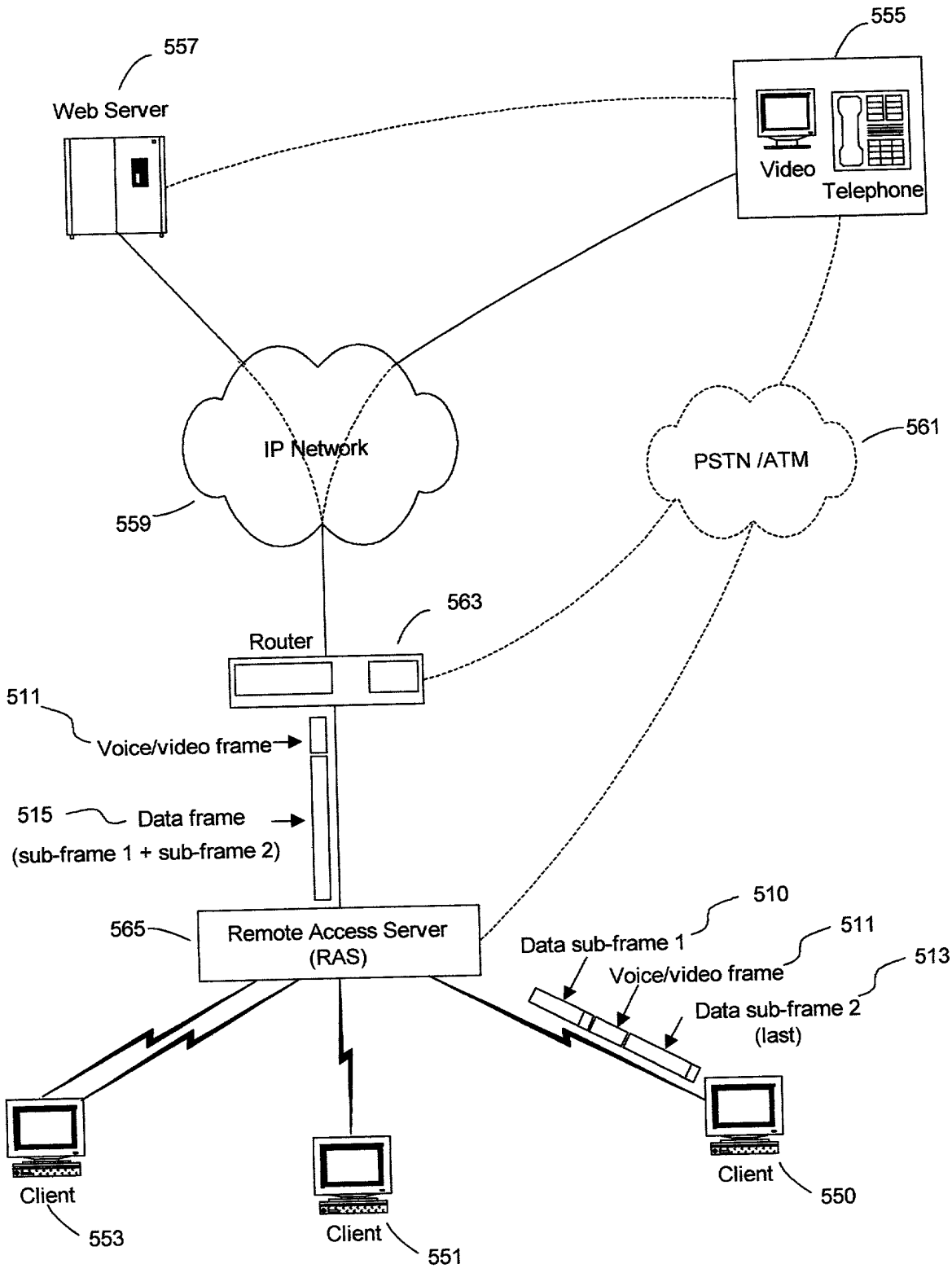

555
557
Web Server
Video
Telephone
IP Network
559
PSTN /ATM
561
563
Router
511
Voice/video frame
515
Data frame
(sub-frame 1 + sub-frame 2)
565
Remote Access Server
(RAS)
510
Data sub-frame 1
511
Voice/video frame
513
Data sub-frame 2
(last)
Client
553
Client
551
Client
550

FIG. 26

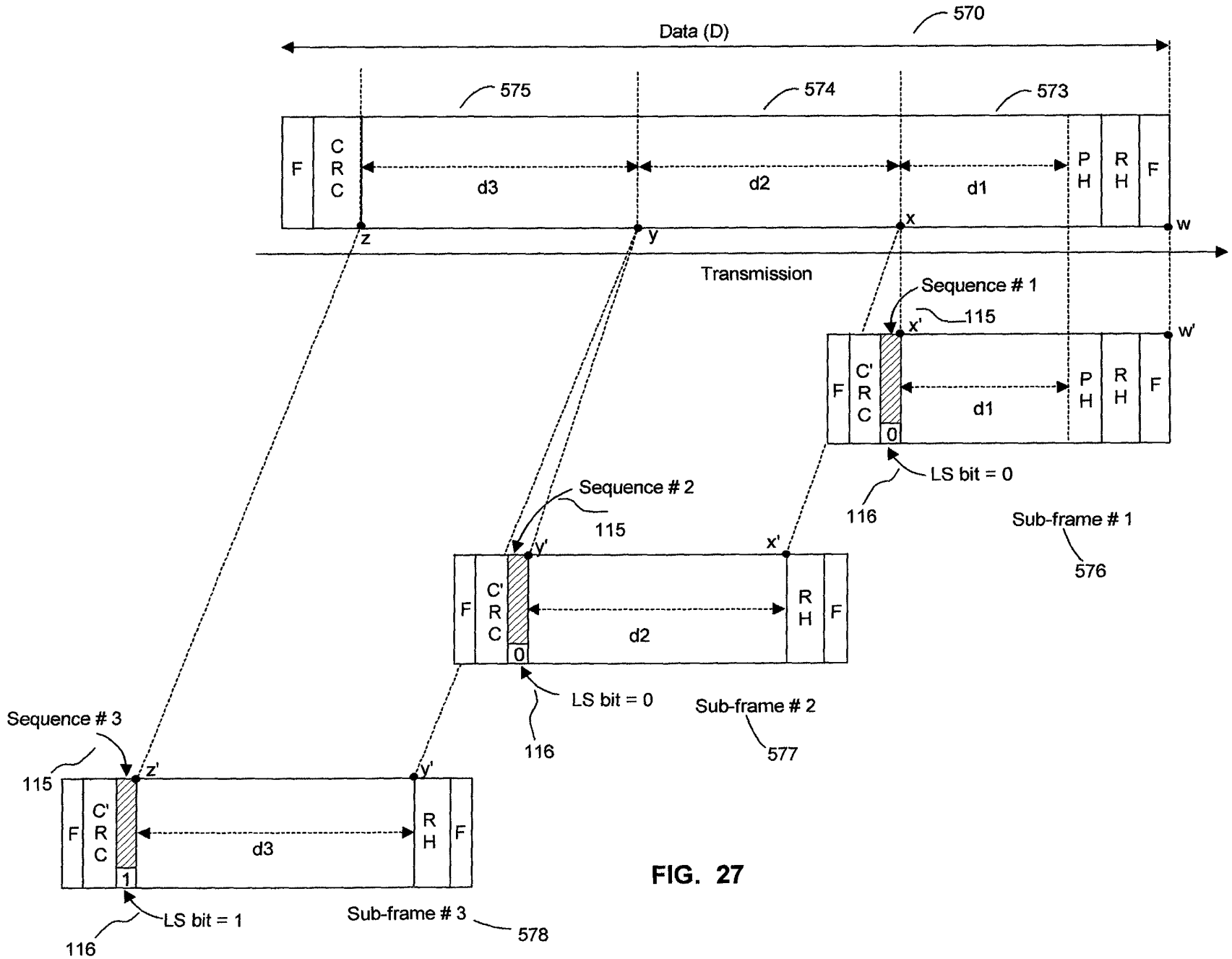

Data (D)
570
575
574
573
F
C
R
C
d3
d2
d1
P
H
R
H
F
z
y
x
w
Transmission
Sequence # 1
115
x'
w'
C'
R
C
0
LS bit = 0
116
Sub-frame # 1
576
Sequence # 2
y'
RH
d2
Sub-frame # 2
577
Sequence # 3
z'
d3
1
LS bit = 1
Sub-frame # 3
578

FIG. 27

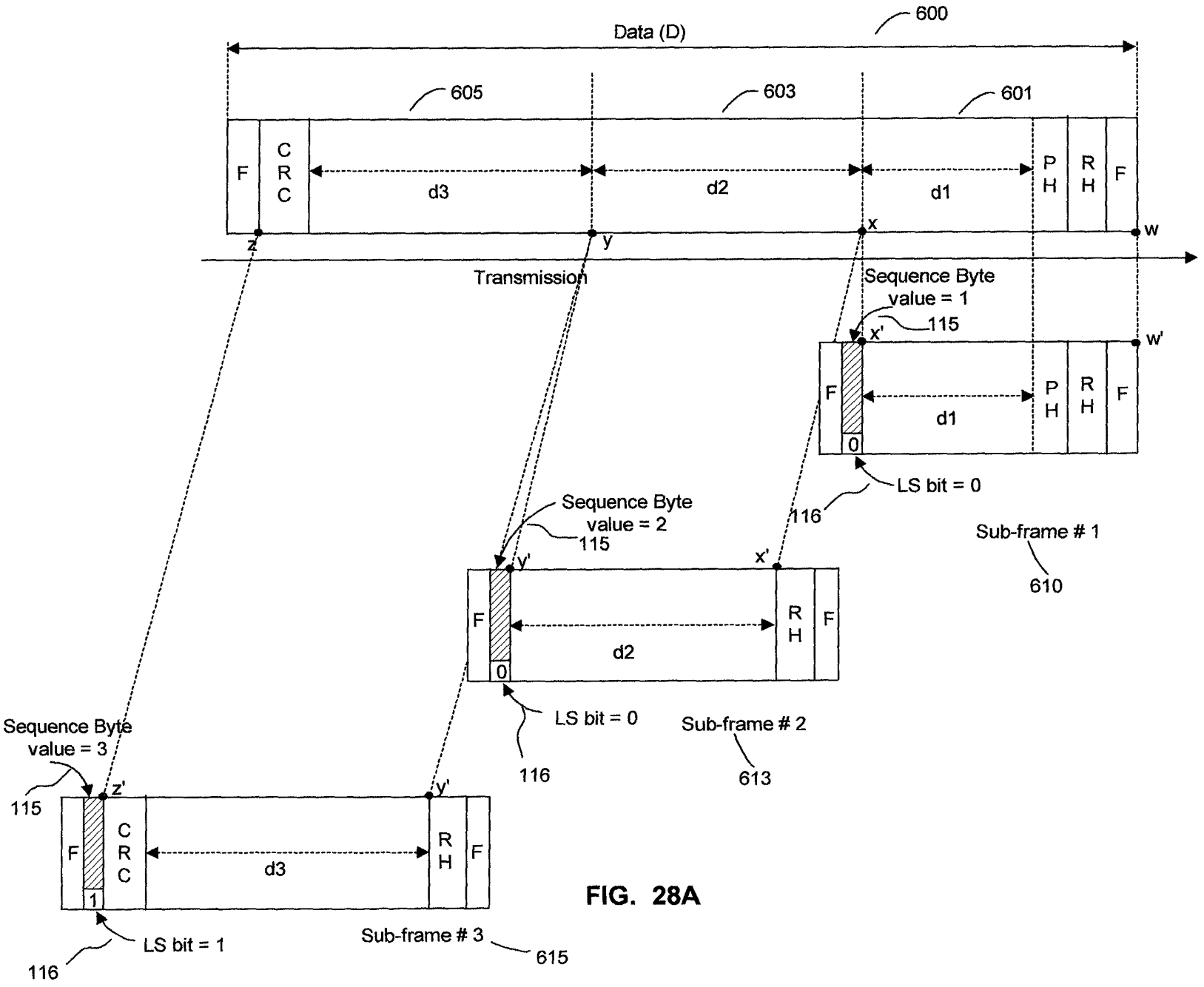

600
Data (D)
605
603
601
F
CRC
d3
d2
d1
PH
RH
F
z
y
x
w
Transmission
Sequence Byte value = 1
115
x'
w'
F
d1
PH
RH
F
0
LS bit = 0
116
Sub-frame # 1
610
Sequence Byte value = 2
115
y'
x'
F
d2
RH
F
0
LS bit = 0
116
Sub-frame # 2
613
Sequence Byte value = 3
115
z'
y'
F
CRC
d3
RH
F
1
LS bit = 1
116
Sub-frame # 3
615

FIG. 28A

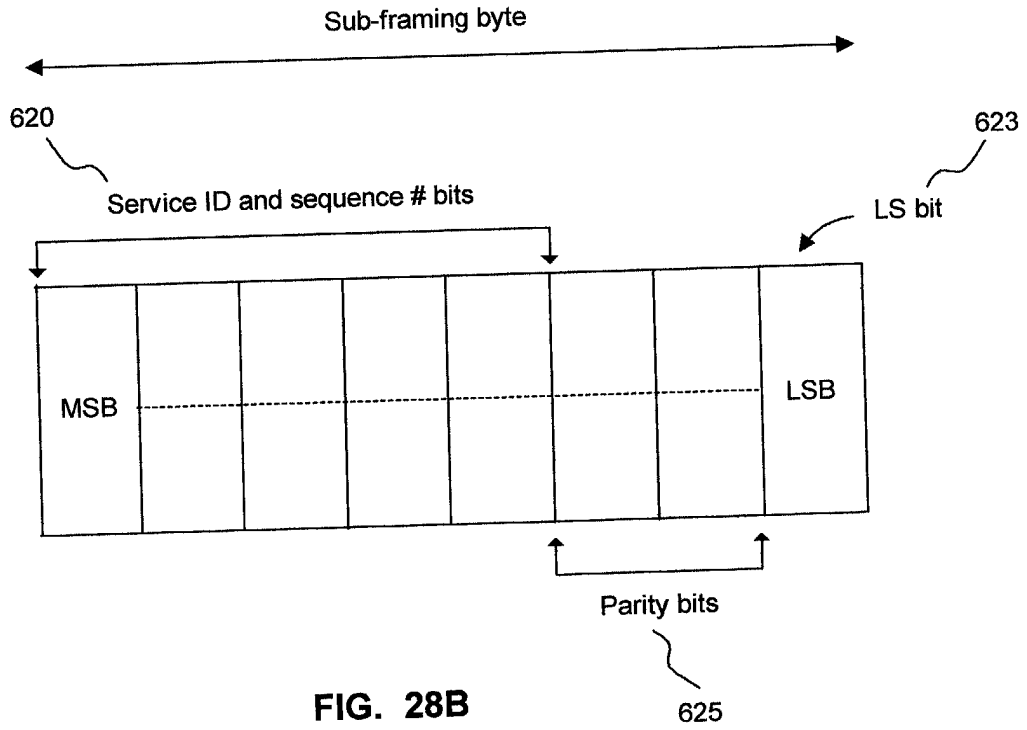

Sub-framing byte
620
623
Service ID and sequence # bits
LS bit
MSB
LSB
Parity bits
625

FIG. 28B